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Place-Based Knowledge in the Digital Age

By Thomas Fisher, Professor of Architecture and Dean of the College of Design, University of Minnesota

In Victor Hugo's *The Hunchback of Notre Dame*, the archdeacon holds up a book before the cathedral and says, "This will kill that. The book will kill the edifice."[1] Of course, we know that the printing press did not "kill" buildings. We still have cathedrals and books, and indeed, most books wouldn't survive very long unless stored in buildings.

But we also know that the book changed cathedrals, which had been thought of as "books in stone," with the stories of the Bible

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Geography: A Platform for Understanding

By Jack Dangermond

At the Esri International User Conference this summer, I shared the context that GIS professionals are working in today: living on a small planet; breathing the same air and becoming increasingly concerned about our future—our personal future, the future of our families and communities, even the future of life on the planet. The evidence suggests that our world is changing rapidly, with many

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Location Analytics: The Next Big Step in Business Analysis

Today it seems that no conversation about information technology (IT) is complete without a discussion about big data, the cloud, or the consumerization of IT. However, arguably, the most impactful trend to hit IT has been analytics—both in media buzz and in corporate investment. Since the publication of Thomas

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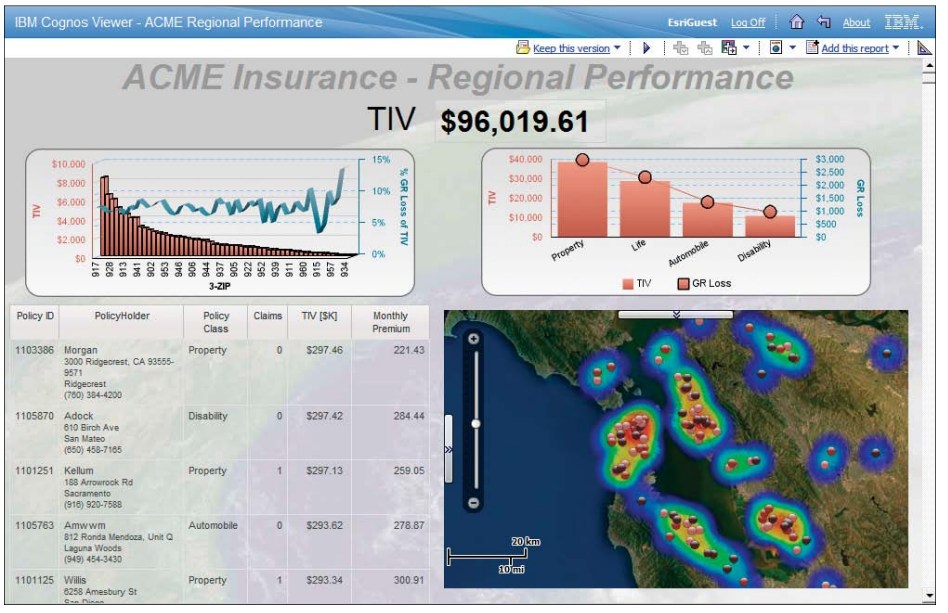
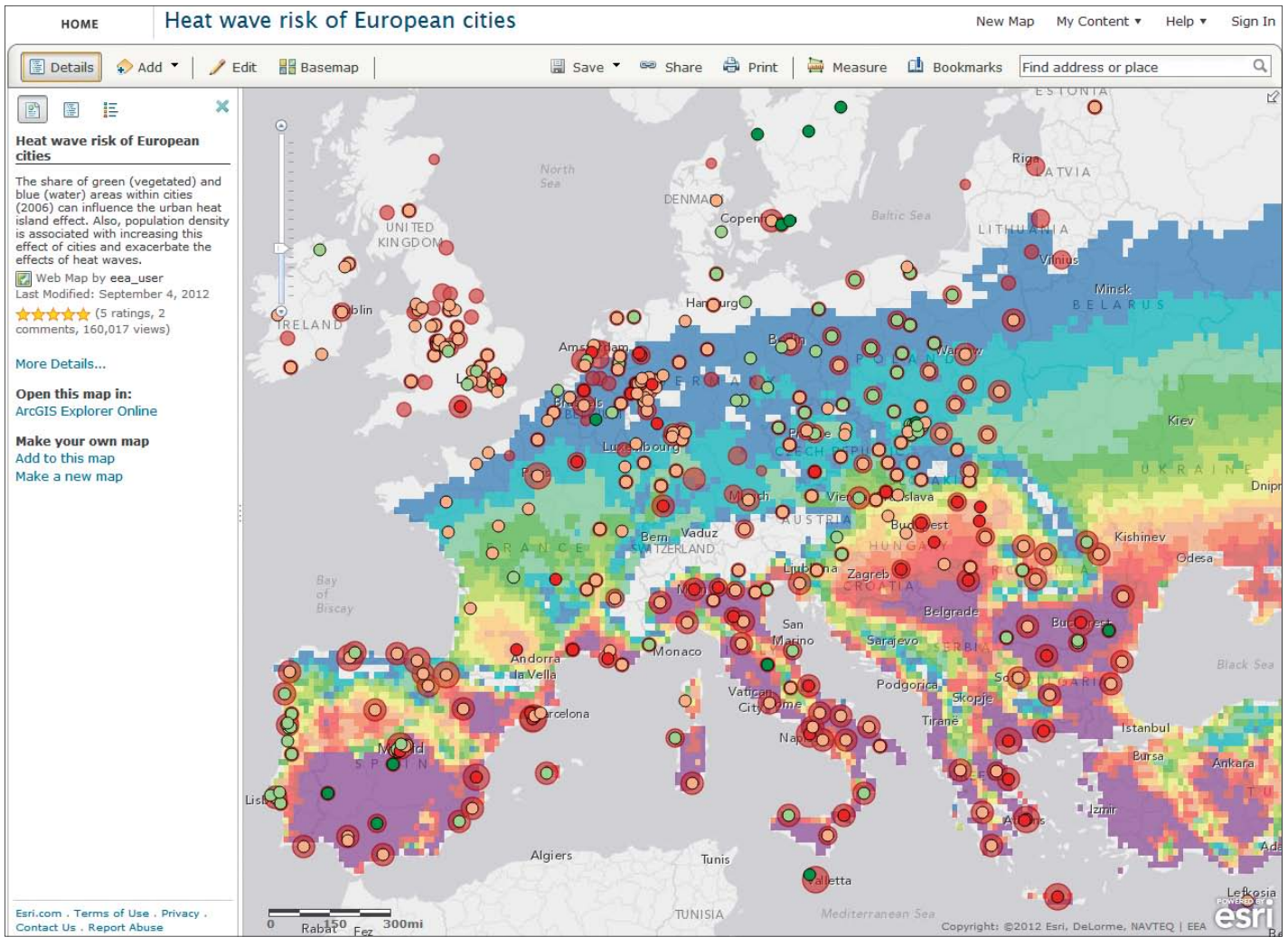


Esri Maps for IBM Cognos highlights regional performance for an insurance company.



The European Environment Agency's heat wave risk map, powered by ArcGIS Online, shows that the southern region of Europe is most likely to see an increase in daytime and nighttime temperatures due to global climate change. *(Source: EEA.)*

ArcGIS Online Helps Tell the Story

European Cities Are Getting Warmer

Less than 24 hours after the European Environment Agency (EEA) posted an interactive web map on its Eye on Earth website, the map received more than 100,000 views. Clearly, the impact of global climate change on weather patterns is of interest to many people, regardless of their location.

The map was originally created by EEA for its *Urban adaptation to climate change in Europe* report (EEA Report No. 2/2012) and shows the heat wave risk for 500 European cities. The map combines the simulated number of both tropical nights and hot days, with population density and share of green and blue urban areas. Vegetation and water areas, along with population density, can influence the urban heat island effect. For example, high population densities are associated with a lack of green space, high building mass, and high production of anthropogenic heat per area. Italy; some parts of southern France; southern Spain; and area around the cities of Belgrade, Serbia, and Bucharest, Romania, are clearly vulnerable.

The heat wave risk map was created by EEA and shared through the Eye on Earth site using ArcGIS Online. The backdrop for the data is the Light Gray Canvas Map, one of the ArcGIS Online basemaps that's well suited to

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European Cities Are Getting Warmer

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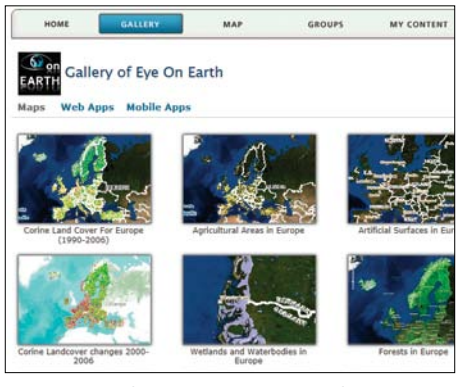
overlaying datasets. The map author added layers of green (vegetation) and blue (water) urban areas extracted from the Urban Atlas product; population density; and combined tropical nights (minimum temperature exceeds 20°C) and hot days (maximum temperature exceeds 35°C) for the periods 1971–2000, 2021–2050, and 2071–2100, an output based on multiple regional climate models from European FP6 project ENSEMBLES *(see below the list of datasets and methodology used)*. The map also includes pop-up windows for the 500 cities that show the city name, city code, and percentage of green vegetation and blue urban area for each location.

This type of map can easily and quickly be made in ArcGIS Online by anyone. Start with one of the ArcGIS Online basemaps best suited to your needs. In addition to the Light Gray Canvas Map, you can choose from street, topographic, and imagery maps. Then simply add the layers—either a layer that has been shared on the web, for example, through ArcGIS for Server or Open Geospatial Consortium, Inc., Web Map Service services; KML or CSV layers; or your own data stored in a delimited text file, GPS Exchange Format, or shapefile. A detailed description and tags provide context and help others find your map.

EEA made the web map publicly available on its Eye on Earth site for anyone to access. The map is interactive, and users can combine different datasets from the EEA report, for example, adding the number of elderly people who are generally more affected by heat. Datasets made available by other organizations can also be added.

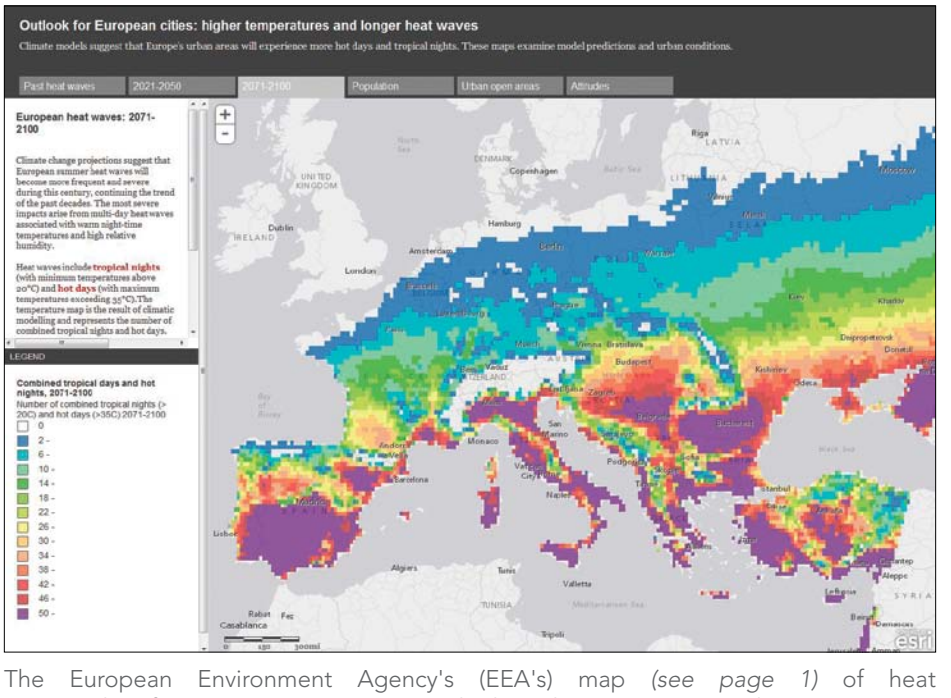


Eye on Earth, EEA's custom website powered by ArcGIS Online, features many environmental maps and invites users to share their observations and data.

To view the heat wave risk map, go to eyeonearth.org, or visit arcgis.com and enter the keywords *heat wave* in the search box in the top right.

Datasets and Methodology Used

- GMES Urban Atlas, reference year 2006
- Urban Morphological Zones (2000)
- Urban Audit database (EUROSTAT)
- Fischer, E. M., and C. Schär, 2010, © *Nature Geoscience*
- European FP6 project ENSEMBLES



The European Environment Agency's (EEA's) map *(see page 1)* of heat wave risk of European cities inspired the above ArcGIS Online story map "Outlook for European cities: higher temperatures and longer heat waves" (look for the map at storymaps.esri.com/stories/2012/warming-cities). Tell your own stories using Esri's storytelling templates at storymaps.esri.com/templategallery and from within the ArcGIS Online map viewer and publish your web maps into them. *(Source: EEA.)*

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Location Analytics: The Next Big Step

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Davenport and Jeanne Harris's book *Competing on Analytics: The New Science of Winning* in 2007, both private- and public-sector organizations have been sold on the notion that they need to leverage analytics on their data to gain insight and drive decision making.

Business analytics has now become pervasive in most large public- and private-sector organizations. Current estimates are that 97 percent of large companies leverage analytics, with over 100 million users worldwide. Users come from across all functional areas, from executives to line operations and from managers to knowledge workers.

These analytic systems basically turn an organization's data into actionable information by discovering and illustrating patterns, trends, and relationships in tabular business data. Typical output is in the form of statistical reports that summarize tabular data and sometimes display this data in graphs and charts. Analytics are often implemented as independent business intelligence (BI) systems but can also be part of larger enterprise systems, like customer relationship, enterprise asset, and resource management systems.

Business Analytics and Geography

There is a growing realization that by adding geographic location to business data and mapping it, organizations can dramatically enhance their insights into tabular data. Maps and spatial analytics provide a whole new context that is simply not possible with tables and charts. This context can almost immediately help users discover new understandings and more effectively communicate and collaborate using maps as a common language. While this geographic aspect has been largely absent from business analytics solutions, many organizations would like to incorporate it into their operations.

For years, a few progressive organizations have integrated maps and spatial analytics with their business data using GIS technology and netted powerful results. This approach has not become widespread because of the expense of custom integration with enterprise systems and because the capabilities of GIS are beyond the technical knowledge of the business analytics users.

A second approach has been the use of consumer web mapping technologies. This has likewise been problematic because of both difficulties with enterprise integration and a fundamental lack of needed capabilities.

Location Analytics—The Missing Perspective

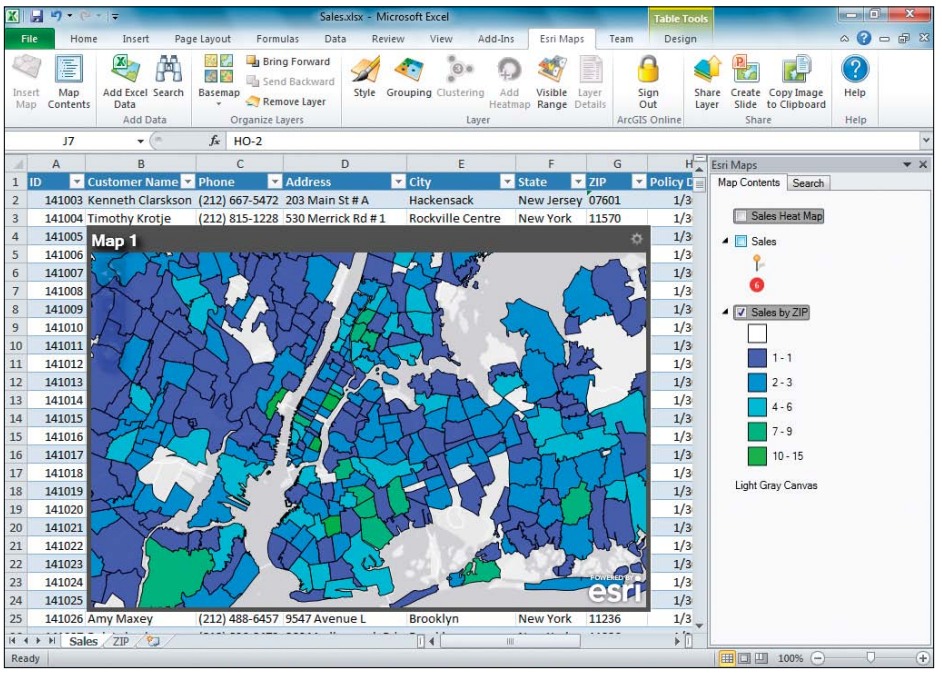
Industry analysts are suggesting that the demand for mapping and geographic intelligence is emerging as an important segment of the business analytics software category. This interest is reflected in the fact that spatial visualization is one of Deloitte's top 10 technology priorities of 2012. This new segment is being called *location analytics* and is focused on thematic mapping and spatial analysis for the world of business analytics. This solution space involves simple mapping and spatial analysis capabilities that work directly with business analytics packages and enterprise data systems with no custom integration efforts.

Esri Location Analytics—Esri Maps

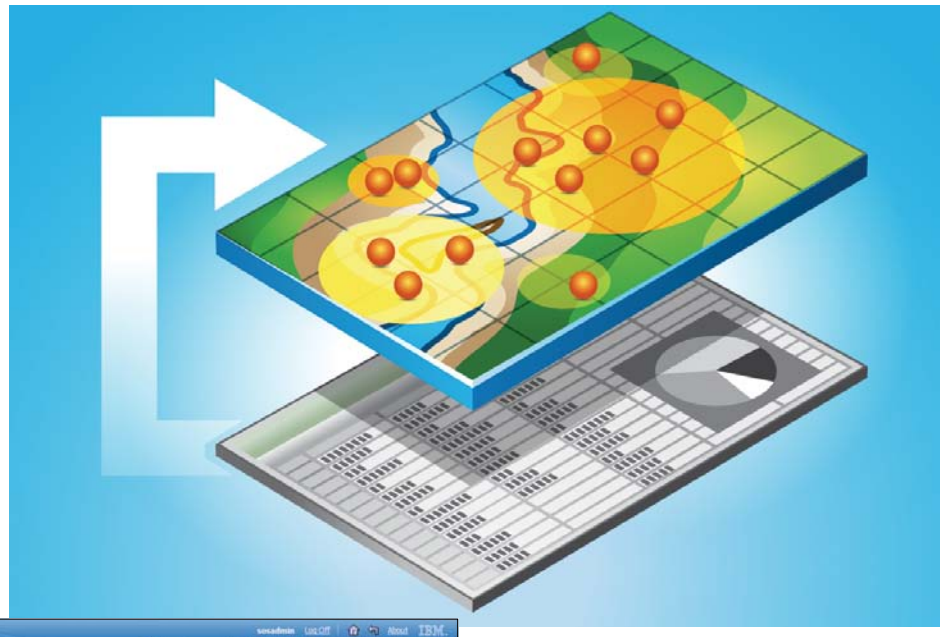
Esri has recently built a simple and powerful solution for the location analytics space known as Esri Maps. This product complements and extends the leading business analytics products, such as Cognos, MicroStrategy, SharePoint, and others. Esri Maps supports easy-to-use mapping and spatial analytics. These capabilities are complemented with a full library of geographic content for enrichment that makes Esri Maps simple to use and inexpensive, and users can immediately make maps of data contained in business analytics systems. Esri's direct integration with leading business analytics platforms means there is no cost for integration or ongoing maintenance. Also, because it is built using ArcGIS (Esri's core technology platform), it can provide powerful GIS analytic capabilities and make use of other GIS investments in an organization.

Specific capabilities include the following:

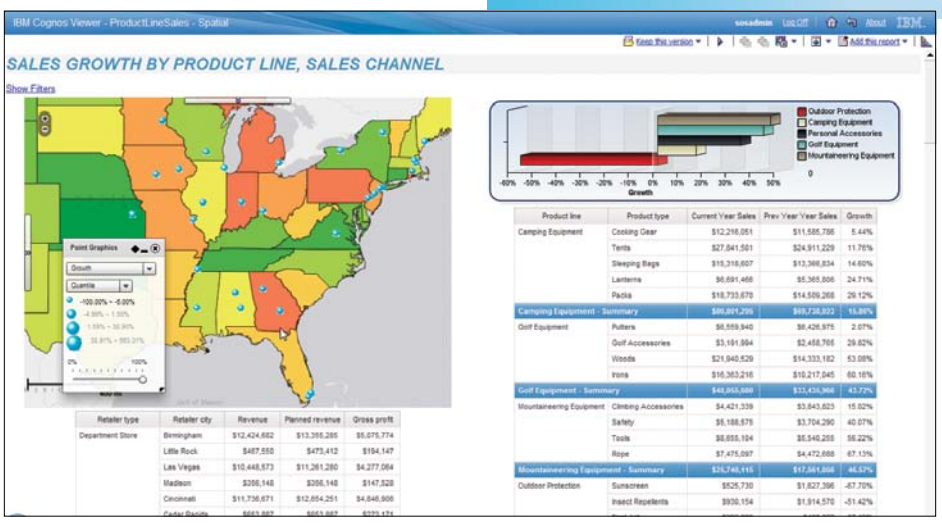
- *Mapping visualization:* Point, color-coded, temporal, clustered, heat maps
- *Spatial analytics:* Bidirectional interaction, map filtering, proximity, custom area (drive time, trade area), and advanced analysis tools (geoprocessing)
- *Geographic information enrichment:* Basemaps, imagery, demographics, consumer and lifestyle data, environment and weather, social media, business, etc.



Esri location analytics brings the power of the Esri platform to existing business systems.



Creating interactive maps inside existing business systems can help users see patterns that graphs and charts cannot reveal.



Business intelligence dashboards are enhanced with interactive maps.

Esri supports multiple business analytics platforms. For example, Esri Maps for IBM Cognos delivers maps, spatial analytics, and geographic information to the IBM Cognos BI environment. Similarly, Esri Maps for Office, a feature of ArcGIS Online, delivers complete location analytics capabilities to Microsoft Office users *[see the article on page 22]*.

The Esri technology augments and extends leading enterprise technology, like BI, customer relationship management, and enterprise asset management, providing mapping, spatial analytics, and geographic data enrichment in a complementary and nondisruptive manner. Users of these systems benefit from enhanced insight into their business data without leaving the business system or changing their information workflow—making these systems more impactful and effective for the users, as well as the business at large.

Enterprise Implications of Location Analytics

While Esri Maps provides a location analytics solution for business analysts, this capability is also part of a larger web mapping platform (ArcGIS Online—arcgis.com) that provides enterprise mapping and geographic analysis services for an entire organization. ArcGIS is used to share, visualize, and analyze all sorts of organization data using geography as a common framework. This system can also dynamically integrate (mash up) all sorts of data, including data that has been mapped using location analytics. When integrated with the growing volume of geospatially referenced data available on the web, whole new insights begin to emerge.

ArcGIS Online is helping enterprises extend the concepts of simple location analytics into whole new areas of information sharing; communication; collaboration; and, ultimately, better decisions. In the private sector, this capability is helping companies be more efficient and create a competitive advantage. In the public sector, it means more effective, transparent, and efficient services.

Location Analytics and Enterprise GIS

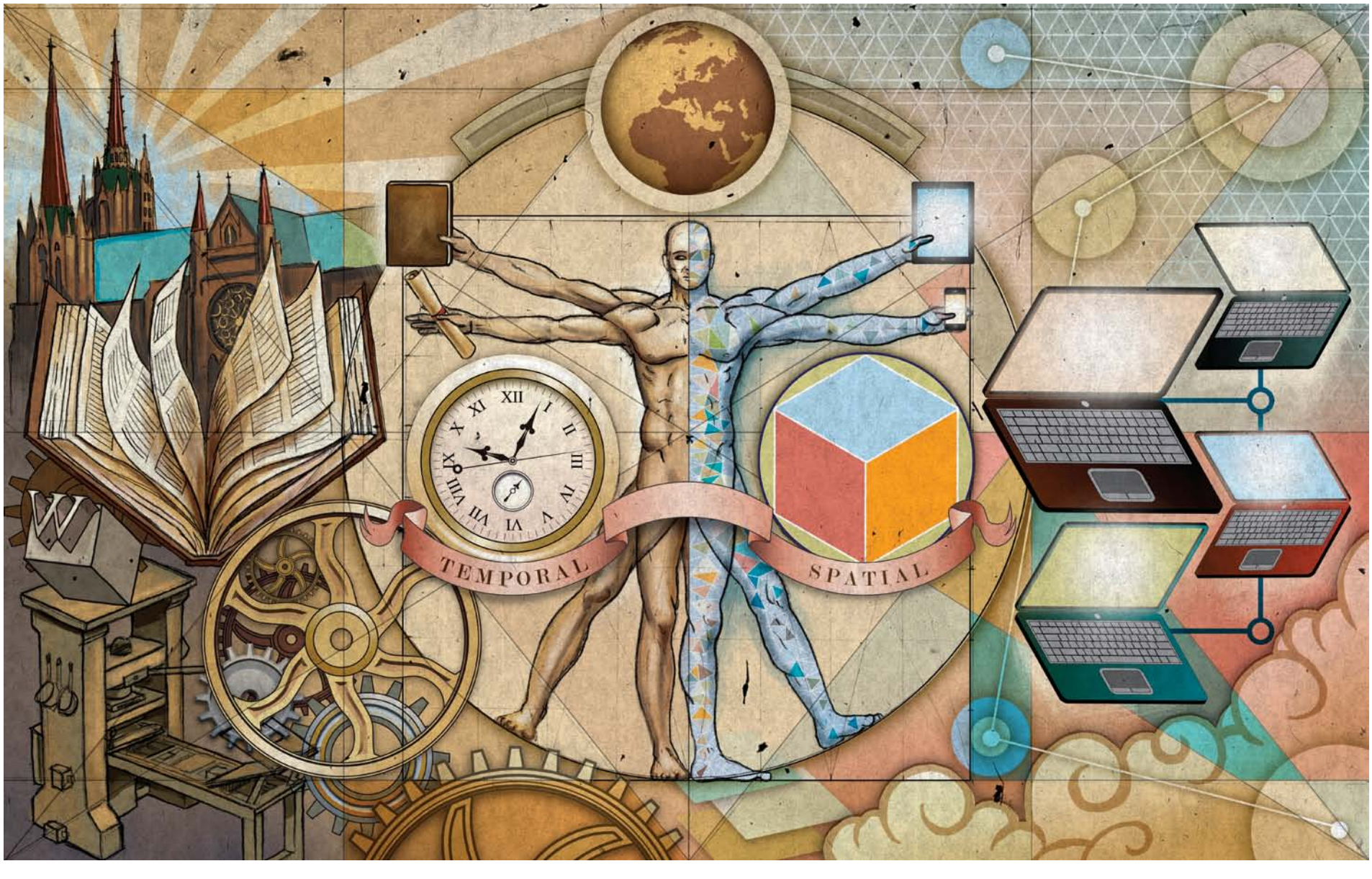
The Esri Location Analytics platform is designed for business analysts who spend much of their day using tools such as BI and Excel to see patterns and relationships in transaction data. They want self-service mapping and simple spatial analytics that are delivered within the analytic systems they use every day. These users will drive the proliferation of location analytics across the organization.

GIS professionals are in a unique position to help these analysts. They are already creating useful frameworks, data, and map layers that let non-GIS professionals, knowledge workers, and anyone in the organization start to use location and geography to make better business decisions.

They can also support this new community and help integrate and leverage their capabilities with other enterprise data to maximize the positive impact.

The integration of mapping and geographic intelligence across the entire enterprise will reinforce and leverage the mission of GIS professionals, particularly in transforming the way organizations leverage geographic knowledge.

For more information, visit esri.com/locationanalytics.



Place-Based Knowledge in the Digital Age

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depicted in the statuary and stained glass of those buildings. We still have cathedrals today, but they no longer have to serve also as books, and so they have changed in fundamental ways, becoming more abstract in form, more diverse in function, and largely shorn of their didactic ornament.

I mention this because we find ourselves at another moment in time where we could hold up a digital device—a laptop, tablet, smartphone, or e-reader—and declare, in front of either a book or a building, that "this will kill that." While we know that such devices will not "kill" books or buildings for that matter, we have also gone far enough into the digital revolution to sense that digital media—and spatial media like geographic information systems—seem destined to have the same kind of effect as the printed book did beginning some 500 years ago.

This brings to mind the observation of Marshall McLuhan that each new technology "turns its predecessor into an art form."[2] Books will indeed survive the onslaught of downloadable e-books, but as we depend less and less upon books for information or even as the most convenient way to access information, we will increasingly value them as an art form, as McLuhan put it—as beautiful objects and works of great craftsmanship, exemplified in the rise of popular institutions such as the Minnesota Center for the Book Arts.

And what about Victor Hugo's claim that books ultimately trump buildings? Downloadable e-books have not "killed" the library as a building type, but as happened with the cathedral after the widespread adoption of the printing press, libraries have increasingly become places where people go to have experiences that they cannot find anywhere else. Like the modern cathedral, the modern library will likely have a greater array of functions; play a more social and less didactic role in people's lives; and, at least partly, lose the primary purpose they once served of storing large quantities of books. It may be that, in the future, we will go to libraries to admire the craftsmanship of books and then interact with others about what we have learned from the information we have downloaded on our portable devices.

The biggest effect of the digital revolution, though, may be less material and more metaphorical. As McLuhan argued, the "medium is the message," with major changes in media leading to changes in our metaphors and to the meanings that we ascribe to the world.[3] The mass-produced book led to a view of the world as a kind of machine, a metaphor that reflected the very thing that made this new media possible: the printing press. And that change in metaphor, in turn, led to many of the revolutions that followed: the Protestant Revolution in the sixteenth century, the Scientific Revolution of the seventeenth century, the Democratic Revolutions of the late eighteenth century, and the Industrial Revolution of the nineteenth century.

The machine metaphor lasted well into the twentieth century and paradoxically gave rise to the very technology—computers—that would ultimately overturn that metaphor. In the early twentieth century, we still heard people talk about the world in mechanistic ways, with intellectuals like Leo Tolstoy calling the body "a living machine"[4] and Le Corbusier calling the house a "machine for living in."[5] Later in the last century, we still heard such mechanistic analogies, such as the physicist Stephen Hawking regarding the "brain as a computer."[6]

Computing, though, also gave us the Internet. And with that, along with the miniaturization of computing in mobile devices, we have gradually realized that computers represent not just a faster form of computation but an entirely new medium, which has brought with it a new metaphor that increasingly dominates our view of the world. It took machines, in other words, to move us from a mechanistic view of reality to a networked one. We no longer view the brain as a kind of computer, but instead as a neural network; no longer speak of society as a well-oiled mechanism, but instead as a social network; and no longer see the human body as a machine, but instead as part of the web of life.

This shift in metaphor matters even more than the media that has prompted it. We will, of course, continue to use machines just as we will continue to use books, and so our material world will remain layered with technologies of the past as well as the present. But when we start to think of ourselves and see the world differently, big things begin to happen, as we saw in the wake of the printing press. Human relationships and social structures change, as we have already seen in the "Arab Spring" revolutions taking place in areas like North Africa, fueled by the crowdsourcing capabilities of cell phone technology; in the micro-lending revolution in the developing world, enabled by the financial transfers possible through social networks; or in the green revolution going on around the world, empowered by our access to information formerly out of reach of ordinary people. The metaphor may ultimately be the message that matters.

The Ecology of Being

This metaphor of the world as a network or web will alter our intellectual lives as well. The old machine metaphor privileged physics, mechanics, and engineering—three of the fields most closely associated with mechanisms. The new web metaphor, instead, draws from fields like biology and ecology, seeing in their understanding of how natural ecosystems work a parallel to the networked world we now occupy and informing us about human ecosystems and how they relate to each other in particular places.

The increasingly weblike way of seeing the world, in turn, has profound implications for how and in what form we will seek information. The printed book offers us a linear way of doing so. We begin at the beginning—or maybe at the end, with the index—and work forward or backward through a book, or at least parts of it, to find the information we need. Digital media, in contrast, operate in networked ways, with hyperlinked texts taking us in multiple directions, social media placing us in multiple communities, and geographic information systems arranging data in multiple layers. No one starting place, relationship, or layer has privilege over any other in such a world.

The linearity of the book, compared to the multiplicity of the web, leads to an even more fundamental shift in how we assess reality: from a temporal to a spatial one. Like reading a book, we see time as an arrow, a linear path with starting and ending points. While we learned from Albert Einstein that we could slow time down depending upon how fast we accelerate, we cannot reverse time or occupy different speeds of time at the same time. But that is not the case with space. Like the web, we can manipulate space, move in multiple directions within it, and reverse it—tear a space down, for example—if we choose.

The worldwide web, of course, often seems aspatial. It connects us to people and places

not in, and often far from, the actual spaces we occupy. Indeed, this new weblike way of engaging in the world appears to have collapsed both time and space, making everything that ever existed anywhere in the world immediately available to us, as if temporal or spatial distance no longer mattered. Such effects, however, disguise the essentially spatial nature of digital media. The laterally linked and complexly networked nature of the web gives it a spatial form, conceptually if not always physically. And the layering of data and simultaneity of information through the web makes it place-based, even if that "place" exists in virtual space.

This line of thinking, in turn, suggests that the current way we store information—through digital documents and files—and distribute it—through e-mail, e-books, e-zines, and the like—may represent a transition stage in this technology. Such formats mimic the forms that emerged from the printing press and paper technology and, because of their familiarity, have enabled us to adapt to the access of digital information more easily. But they also reinforce a linear way of thinking about information inherently at odds with the weblike way in which we increasingly see the world.

GIS will eventually become a major way—perhaps the dominant way—in which we will access information in the future because of the essentially spatial nature of that software. Rather than see information as discrete bits, accessed linearly and temporally, like moving along a necklace of data, GIS layers information spatially, linking it according to its relevance to other data on a given layer and according to its relevance to all the other layers in a given place. It allows us to "map" information, which may become the primary way we organize, access, and distribute knowledge in the future.

This use of spatial tools to match the spatial nature of a web will have a profound effect on how we think about information itself. The book led us to see information in highly discrete ways. By packaging related content between two covers, books encourage us to see knowledge as a set of distinct disciplines, each with its own discourse and eventually its own set of assumptions and use of language that made it increasingly hard for anyone else not in that discipline to understand. And by sorting information according to disciplines, books enabled us to think of knowledge divorced from any particular physical or conceptual space. As a result, we can take almost any subject—say, water—and find that topic addressed in myriad ways by many disciplines—the sciences and social sciences, literature and history, art and poetry—all located in different places in a library and all addressed in different ways through different disciplinary lenses.

That way of organizing knowledge has served us well in the last several centuries as we have sought to understand and control the world around us. But it's gotten in our way in recent decades, as we have come to realize the damage we have done to the world and the threat that that poses to our civilization and to us. It has led, for example, to what Adam Smith called the paradox of value, when he asked, at the beginning of *The Wealth of Nations*, why we so value diamonds that have so little real use, and why we don't value water, without which we cannot live.[7] By dividing information into discrete, disciplinary units, we have created what we might call the paradox of knowledge: in which we have so much information about the world and yet remain so ill informed about our effect on the world.

This suggests that we may need to arrange knowledge differently in the future, not according to disciplinary categories, but instead according to spatial phenomena and, as Smith would say, to the things without which we cannot live. GIS offers one way of doing so. While the data-rich digital mapping of GIS arose, initially, to ease geographic analysis and enhance spatial decision making, it has the potential to organize knowledge in ways that align more closely with the ways in which the world itself is organized: spatially.

That may make sense in spatially oriented fields, like geography, forestry, or planning, but how, you might ask, does that make sense for fields that appear to have no spatial equivalent: philosophy or pharmacy, history or histology, literature or linguistics? It's a good question, but maybe the wrong one to ask. It may be that we need to stop asking how to preserve our disciplines, which, for all their value, remain abstractions of or at best partial views of the world, and instead start asking how to preserve what remains of the natural world, which our disciplines, if they have any value, need to serve.

Spatializing Knowledge

How might GIS help us spatialize knowledge? Rather than organize knowledge by type or discipline, we could use GIS to embed all the knowledge relevant to a place in the myriad layers of information about it. And as we scroll over a place, we can select the pertinent layers and begin to see the relationships among disciplines and the connections among data. So many talk about the need for interdisciplinarity, but as long as we organize knowledge in disciplinary silos, the connections among disciplines will continue to elude us. When we instead begin to organize knowledge spatially, the connections come to the fore, as we focus less on the layers and more on the overlay of them and on their relevance to particular situations.

This, of course, may seem too much to ask: the reorganization of knowledge and the spatializing of education. We have, however, managed over the last couple of centuries to temporalize education. Every field has a history, and almost every one requires that students study the history of the discipline as part of knowing it. Indeed, historical understanding has become such a part of what we define as an educated person that we take it almost for granted, but it wasn't always so. It wasn't until the nineteenth century that we assumed, as Georg Hegel argued, that we couldn't fully comprehend anything without knowing its history.

In the first decades of the twenty-first century, we need to see that the same holds true for space as much as it does for time. We cannot fully understand any field without also spatializing it, without also seeing how it relates to every other discipline as they come together in particular places, with a given group of people, in specific social and environmental contexts. We need to know how disciplines evolved over time, but we also need to know how they, so to speak, hit the ground and how they play out as part of the web that constitutes the whole of a place and of the people there.

This does not mean that we should see such spatial analysis as an end in itself. Except for historians, we rarely study temporal phenomena—history—as an end in itself. In most fields, history serves as a means to an end, as a way of better understanding how the present came to be and what the future might hold. The same is true for a spatial understanding of our fields. Except for a few fields, like my own field of architecture, which does study space as an end in itself, most disciplines will likely see this weblike, spatial turn in our thinking as a means of understanding their subject in new ways. Space represents, like time, an a priori condition, as Immanuel Kant argued—a precondition to everything else, and so having a sense of the relationship of space and time—how a field evolved spatially as well as temporally, what happened where as well as when—will increasingly become necessary to fathom how we have done so much damage to so many places and to the

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cultures of so many people on the planet even as we purportedly know more about them.

The spatializing of knowledge via its mapping onto places has another advantage as well: it becomes a visual way of conveying information across the barriers of language and to the growing percentage of the human population that remains illiterate. The book divides the literate and illiterate and, as such, has helped reinforce the power of the former over the latter. Hugo understood that when he had the archdeacon hold up the book as killing the building. The medieval cathedrals spoke to both the literate and illiterate and, in some respects, the book made large stores of knowledge inaccessible to the latter.

The digital divide threatens that as well, with the wealthier parts of the world having much more access to information than the poorer parts. The web and cloud computing may help end that division by making most of what we need to know available at low cost, with "dumb" devices able to access information anywhere in the world. But there remains the problem of literacy, as well as translation, and so closing the digital divide through such devices will only partly close the gap that exists between those who have access to knowledge and those who don't.

We may never close the latter until we spatialize knowledge through the use of visual tools like GIS. Enabling people to see the information relevant to their lives, whether or not they can read, and to map it to the places they know to understand the conditions that affect their lives, could have a transformative effect in empowering those who have been left behind by the book and even by the early incarnations of the computer.

GIS may represent the leading edge of computer mapping and visualization technology, but it also signifies, in some respects, a return to the world that Hugo's archdeacon saw as threatened. This brings to mind the observation of the novelist and semiotician Umberto Eco—that modernism represented a premedieval condition, which suggests that our post-postmodern world may have more characteristics in common with the medieval world than we have recognized.[8]

If the medieval cathedral tells its stories in stone and glass, GIS tells them through layers and overlays. Both do so visually and spatially, both speak to viewers whose language or even whose literacy may not matter, and both reveal relationships and meanings that no book could ever capture. At the same time, the medieval cathedral and digital cartography both have the power to move us to action, to help us see things with our own eyes and without the interpretation of an author who might want to edit what we know or affect what we think.

Just as the book helped give rise to the Protestant Revolution, in which people wanted to read the Bible for themselves and make up their own minds, so too might the visual and spatial power of GIS someday give rise to a secular version of the same, in which people, protesting the power of a few to control so much of the knowledge about the world, will want to see that information for themselves and make up their own minds.

Geodesigning the Future

This leads to my final point about the spatializing of knowledge. The temporalizing of knowledge has, through the agency of history, helped us understand the past and possibly comprehend how the present came to be, but rarely do we venture very far into the future. We call that science fiction or fantasy to set such future-oriented thinking apart from what we can reliably know about the world as it is or as it once was. And we tend to see such work as somehow of lesser quality or validity than what the sciences, social sciences, and humanities offer.

But spatial understanding has a different relationship to the future, as well as the past and present. Spatial knowledge recognizes place, rather than time, as the ultimate continuity in our lives. And while none of us can see the future as a temporal idea, we continually imagine the future of places, projecting possible spatial arrangements based on what we see around us.

The design disciplines do this all the time, using spatial means to imagine what could be, envisioning the future of a place, product, or environment, and depicting that visually for others to see. We commend or criticize a design and accept or alter it to fit our idea of what should happen in a particular place or with a particular product. We don't consider design a lesser discipline, simply a different one, operating according to its criteria and assumptions.

I mention this because the leading edge of GIS rests with the idea of "geodesign," the use of geographic analyses of what is as the basis of making design decisions about what could be. Rather than see future-oriented thinking as somehow fiction or fantasy, geodesign allows us to connect what we know about the world with what we might want the world to be. Just as GIS can serve as a means of organizing knowledge spatially, geodesign might serve as a means of projecting that knowledge into the future and assessing its merits based on what we know about a place.

Why does this matter? Because we stand on a similar precipice as Hugo's archdeacon, with even more drastic implications. We might well say that "this will kill that," but in our case, "this" represents modern civilization and "that," the natural world. Since the rise of the book, although not necessarily because of it, we have devised a Ponzi scheme with the planet over the last couple of centuries, exploiting natural resources, other species, foreign cultures, and even future generations to keep those at the top of this pyramid scheme enriched.

As we know from the collapse of other, smaller Ponzi schemes, such frauds cannot last. They tend to collapse suddenly and without warning, and those most enriched by the scheme—us—have the farthest to fall. The only way we can avoid such a fate is to realign our relationship with the natural world, to reorganize our considerable knowledge about it to reveal the forces that lead to our unsustainable practices, and to relearn how to steward what remains of the planet we have so altered. And if we don't, we have only to alter the terms of Hugo's observation only slightly. *This*—the collapse of our Ponzi scheme—will kill *that*—the civilization we have built up over the last 200 years.

The spatialization of our knowledge, in other words, isn't just an academic exercise or the result of some arcane interest of a few spatial thinkers or GIS specialists. With it, we can begin to set the foundation for a more sustainable future for ourselves as we see the impact of our actions and the relevance of our knowledge to the particular places in which we live. This will not kill anything except the ridiculous illusion that we can continue to live beyond the carrying capacity of our planet. And doing so is not just about space; it's about time!

About the Author

Thomas Fisher is a professor in the School of Architecture and dean of the College of Design at the University of Minnesota in the Twin Cities. This paper is based on Fisher's keynote address to the GeoDesign and Spatializing the University meeting of the Big 10 university librarians, May 2012.

For more information, contact Thomas Fisher, University of Minnesota (e-mail: tfisher@umn.edu).

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Geography: A Platform for Understanding

continued from cover

Jack Dangermond speaking at the 2012 Esri International User Conference. Watch his opening talk at esriurl.com/4936.

trends that will be challenging for us personally and our organizations for the rest of our lives.

At the same time, we are living in an amazing time when scientific discovery and technological advancement are accelerating dramatically. We are making huge scientific discoveries and creating unfathomable volumes of data in the process. But these advances and the simple volume of data aren't enough. Clearly we need more integrated knowledge and ways to be able to make better decisions and create better outcomes. We need to harness our technology and our brain power to create a more sustainable future.

Geography

The role of geography is a platform for understanding the world. GIS is making geography come alive. It condenses our data, information, and science into a language that we can easily understand: maps.

These maps help us integrate and apply our knowledge. The same maps tell stories—stories about almost everything in our world. We need to better harness the power of GIS maps to engage everyone, telling the stories of what's happening to the world and creating maps that create a better future, a future with better outcomes.

I'm increasingly confident that our GIS community will do this. One reason is that GIS itself is advancing; it's getting more powerful and easier to use. It's evolving with lots of new capabilities. It's also moving to a new web/cloud based platform; one that will make GIS pervasive. GIS will evolve to a new level, creating "geography as a platform."

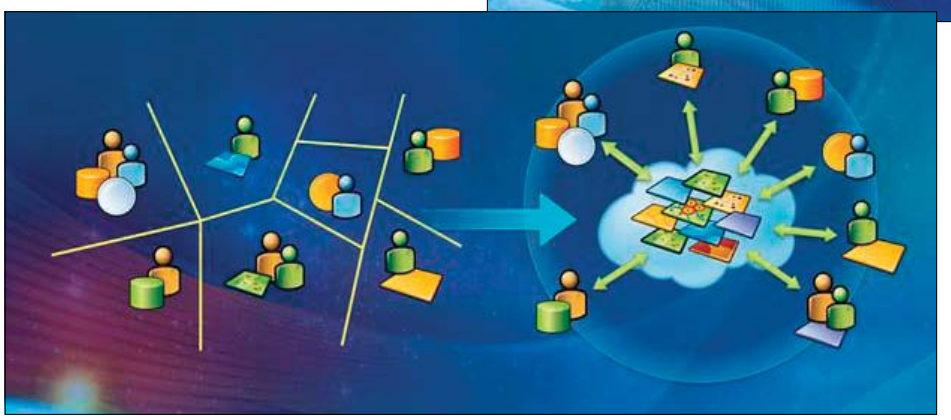
Reimagining Our World

This new platform allows geographic knowledge to be widely shared, enabling widespread access and use of GIS.

At the same time, other trends, such as widespread measurement, big data, and ubiquitous computing, are advancing rapidly, including Software as a Service computing, device computing with lightweight and locationally aware applications, as well as supporting scientific exploration and innovation.

The convergence of GIS with these trends will enable us to integrate geographic knowledge into everything we do.

This new pattern integrates all types of geographic information—maps, data, imagery, social media, crowdsourced information, sensor networks, and much more.



Cloud GIS changes the discussion, breaking down barriers between workflows, disciplines, and cultures.

Cloud GIS enables ubiquitous access and integrates the traditional work of geospatial professionals with a whole new world of GIS applications. It takes what have been relatively scarce commodities—stories and actionable geoinformation—and makes them abundant. Web maps provide the medium for integration and understanding and make this information widely accessible in simple forms. This widespread, easy access to geographic knowledge is what we mean by providing geography as a platform for understanding.

A New Pattern

This new pattern breaks down the barriers between different workflows and disciplines and brings them together. This will enable us to better collaborate and share, as well as approach problem solving and decision making more holistically.

Cloud GIS enables pervasive access, integrating traditional GIS with a whole new world of applications.

We are already starting to see organizations rapidly adopt this new pattern. The European Environment Agency, the United Nations Environment Programme, the World Bank, and many United States government agencies are adopting it. They are using cloud computing to support their own mission and, at the same time, sharing their knowledge with others. By sharing their geospatial knowledge in common cloud environments, they are creating a new kind of spatial data infrastructure.

Enabling the Platform

The sharing of geospatial knowledge will open our world and create a new level of understanding. As more organizations embrace this idea and adopt a culture of collaboration and sharing, the GIS community will benefit greatly. GIS practitioners will be able to do their work better and elevate the role of GIS in our organizations.

Our work at Esri is about enabling our users to do their important work. We take that responsibility very seriously. I thank you for entrusting us to do that.

Esri International User Conference Overview

Opening Our World to a Better Future

An international community of scientists, technologists, and decision and policy makers gathered at the largest GIS conference in the world, the Esri International User Conference (Esri UC), which convened July 23–27, 2012, in San Diego, California. People came to learn, discover, and share ways geospatial technologies are helping them design a better future. This year's conference theme was "GIS—Opening Our World."

Jack Dangermond, president of Esri, opened the conference by welcoming nearly 15,000 attendees who represented 126 countries. In his presentation, Dangermond noted how quickly the world is changing. He described the roles data, analysis, and sharing play in understanding conditions and events and creating common operating pictures that help people plan and respond rapidly. He explained that this is best done on cloud platforms where people can work together to solve problems. Esri is moving its technologies to the cloud so that users can integrate and share all types of geospatial data, maps, models, and applications *[see the article "Geography: A Platform for Understanding" by Jack Dangermond on page 1]*.

"GIS today is at a major turning point because it is now capable of broadening its reach and enabling pervasive adoption," explained Dangermond. This said, he described geography as a platform, a system for the entire organization that delivers enabling technology to anyone, anywhere, on any type of device. Dangermond announced that Esri has made ArcGIS Online, Esri's hosted map service, a fundamental part of ArcGIS enterprise integration, thereby opening interoperability with core systems. ArcGIS Online is agile and flexible and can be configured to meet an organization's specific needs *[see article on page 22]*.

Dangermond also talked about ways Esri's location analytics are improving business practice *[see article on page 1]*. Esri provides Software as a Service as a business model that works in the ArcGIS Online environment wherein users can find content and ready-to-use workflows. Business systems, such as IBM Cognos and Microsoft Office, are now geoenabled to provide geographic insight within various types of business intelligence.

Dignitaries and CEOs attended the Esri UC, including the keynote speaker for the Plenary Session, Julia Marton-Lefèvre, director-general of the International Union for Conservation of Nature (IUCN) *[see the article on page 9]*. She addressed the problem of species loss and talked about the IUCN Red List of Threatened Species map portal that accesses a vast dataset of more than 30,000 georeferenced species (**maps.iucnredlist.org**). Peter Carlisle, mayor of Honolulu, Hawaii, shared how his city has used ArcGIS to create a geodesign for its rail transportation project. Bruce Wong, manager of network analytics at General Motors, shared how successful location analytics helped transform the company. More than 800 senior executives attended the conference.

Esri chief scientist Dawn Wright presented Esri's new Ocean GIS initiative: "GIS technology, which has long provided effective solutions to the integration, visualization, and analysis of information about land, is now being similarly applied to oceans," she said *[see the article on pages 12 and 13]*.

Every year, Esri highlights students who use GIS in the classroom. This year, four students and their teacher from the GIS and environment class at Washington-Lee High School in Arlington, Virginia, presented their senior projects. Students took real problems, defined them, and created GIS solutions from beginning to end and from analysis to creating maps with ArcGIS Online to a mobile application. These projects included the design of a web application for labeling storm outlets; the use of lidar to analyze the impact of the Washington, DC, Metro on population and surfaces; and the identification of wetlands using automated infrared processing and an image classification tool.

The Esri UC had something for everyone, from the professional to the novice. The GIS Managers' Open Summit provided a setting for GIS managers, business administrators, and technology strategists to meet and engage in conversation with their peers. GIS experts had an opportunity to share their work at the User Software Applications Fair, the Map Gallery, Lightning Talks, and paper sessions. This year, 35 percent of the attendees were new to the conference. At the GIS Solutions EXPO, many of them joined the Hands-on Learning Lab, watched product and application demonstrations, and spoke with members of Esri's technical support team.

GIS developers participated in events new to the conference. Esri set up the Hackers Sandbox, in which developers played with new developer tools and built their professional GIS developer network.

At the UX Design Summit, Esri professionals explained ways to improve application usability. The Speed Geeking event was a platform for developers to give five-minute Lightning Talks about topics of interest. A Dev Meet Up, part of a nationwide event series, was also held at the Esri UC.

During the technology workshops, Esri showed the capabilities of ArcGIS 10.1, as well as new tools, workflows, and applications. The overriding benefit of Esri product developments is that they create an interactive, common operating picture, which incorporates web applications created on ArcGIS for Server, and Software/Data as a Service provided by ArcGIS Online.

Esri recognized special people and organizations by presenting its annual awards. The Lifetime Achievement Award was given to renowned landscape architect Stephen Ervin *[see article on page 10]*, the President's Award acknowledged the US Environmental Protection Agency, and two Making a Difference Awards were presented: one to the Trust for Public Lands and the other to Carlisle. The US Geological Survey was given a special mention for its 40-year-old Landsat program and thanked for making this data available for free *[see the article on page 17]*. In addition, Esri celebrated the outstanding work of more than 160 businesses, governments, and organizations around the world at the Special Achievement in GIS Award ceremony. During the closing session, mapping awards were presented.

Although the conference is concluded, you can still learn about the latest trends and technologies. **Esri.com/uc** is a valuable resource for viewing the plenary talks; listening to technical session podcasts; and reading conference proceedings, such as user presentations.

The next Esri International User Conference will be held at the San Diego Convention Center, San Diego, California, July 8–12, 2013.

Julia Marton-Lefèvre Announces Release of Red List Portal

Threatened-Species Authority—Esri User Conference Keynote Speaker

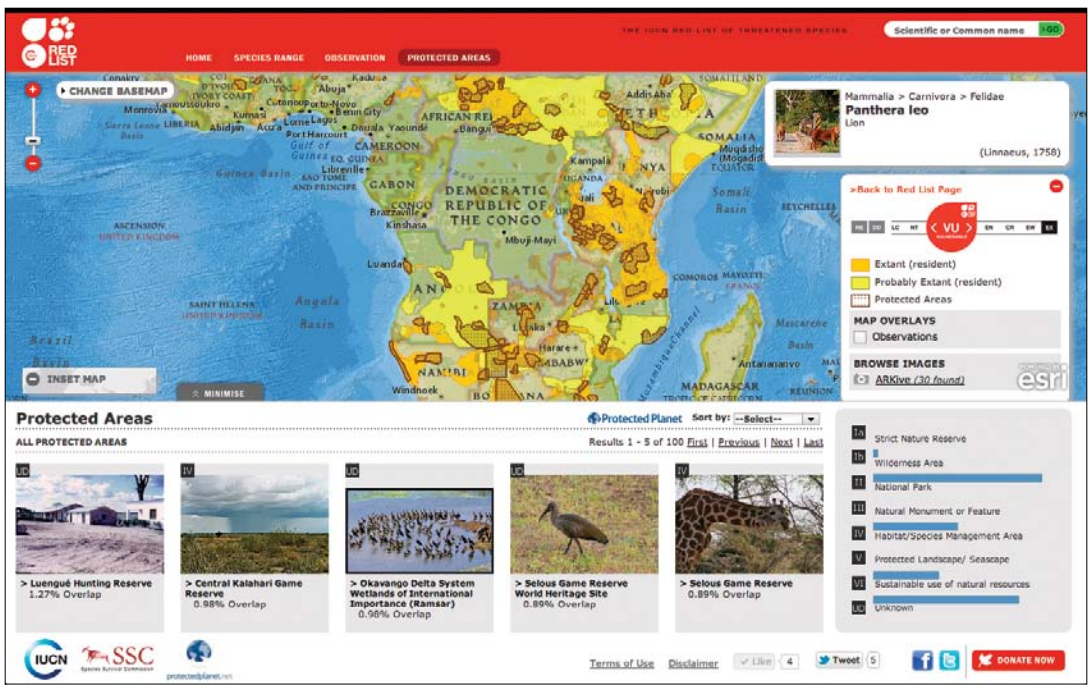
Julia Marton-Lefèvre

Julia Marton-Lefèvre, director general of the International Union for Conservation of Nature (IUCN), the world's largest conservation/environment membership organization, was the keynote speaker at the Esri International User Conference Plenary Session in San Diego, California, on July 23, 2012.

Marton-Lefèvre is distinguished in the global conservation community for her commitment to sustainable management of natural resources. "Our mission is to influence society to conserve nature and natural resources in an equitable and sustainable manner," she said. "Using cutting-edge geographic knowledge, IUCN mobilizes conservation action for the benefit of nature and the seven billion people who depend on it."

The IUCN Red List of Threatened Species is the most comprehensive information source on the status of wild species and sets the world standard to measure the extinction risk of plant and animal species. During her presentation, Marton-Lefèvre announced the release of the map portal for the IUCN Red List of Threatened Species.

Marton-Lefèvre explained the value of GIS for identifying location information for the several thousand species on the Red List, including all known mammals, birds, and amphibians and a quarter of the world's known reptiles. "GIS helps us define areas of heightened biodiversity importance and thereby guides decisions about the conservation action and policies for these areas," she said.



The geography of lion habitats can be studied and analyzed on the IUCN Red List of Threatened Species map service portal. See also the IUCN story map "A Gallery of Amazing Species" (storymaps.esri.com/stories/redlist/#overview).

The IUCN Red List of Threatened Species

IUCN's enormous knowledge center provides researchers with a base for studying species trends and helps policy makers understand where conservation action needs to occur and be enforced. IUCN's data and data from other species organizations is accessible via the IUCN website (**www.iucnredlist.org**). The site includes an interactive map service, which is a GIS portal that allows visitors to easily visualize species' ranges and examine an abundance of scientific data (**maps.iucnredlist.org**).

For example, if people are interested in the species status of *Panthera leo* (lion), they can learn about it by searching the IUCN Red List of Threatened Species. GIS shows the locations where lions have most recently been reported, the limits of the lions' distribution range, and photos of lions taken at these locations. Moreover, users can engage with GIS. For instance, they can overlay the provided basemap with protected-area data and the range of the lion to see where the species is safe and where it is not. GIS shows threats to species, such as habitat loss caused by human encroachment and indiscriminate trophy hunting by poachers.

In addition, the portal links to thousands of geotagged wildlife images. It draws source data from ARKive, *Encyclopedia of Life*, Global Biodiversity Information Facility, iNaturalist, and World Database on Protected Areas from the United Nations Environment Programme World Conservation Monitoring Centre.

The Find Species Near Me tool allows users to see a map of species in their area, including a species list, along with their Red List status.

The Species Map Editor tool helps scientists who have GIS skills easily enter species distribution data on an attribute form and digitize location areas using drawing tools to draw ranges.

IUCN georeferenced data is searchable on ArcGIS Online and is linked to the IUCN site for data download.

How It Was Built

Built on Esri ArcGIS 10.1 for Server, the IUCN Red List of Threatened Species portal seamlessly brings together six databases in a JavaScript-based application designed by Esri Partner Blue Raster (Arlington, Virginia). The application was deployed with the latest ArcGIS API for JavaScript version, which allowed the best user experience and performance for a global audience. The complex species range data was optimized for web delivery that provides access to the entire catalog of species ranges without sacrificing data display quality. The IUCN Red List of Threatened Species also leverages web services in open standards from several sources to provide seamless web maps with species observations (photos), range data, and protected-area intersections. The entire system is hosted by Amazon Elastic Compute Cloud, which enables IUCN to rapidly publish its applications. With a global audience relying on the IUCN Red List of Threatened Species for this critical data, the mapping tool is proving to be a very powerful device for conservation.

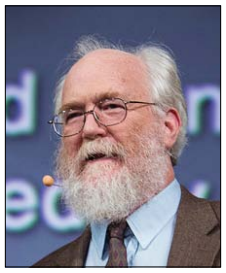
"The addition of GIS has changed the face of IUCN Red List of Threatened Species," concluded Marton-Lefèvre. "The technology has made it possible for threatened species information to be included in the decision-making process."

For more information, visit **www.iucn.org** or **www.iucnredlist.org**.

Dr. Stephen Ervin Celebrates the Coming of Age of Geodesign

Ahead of His Time

GIS Hero



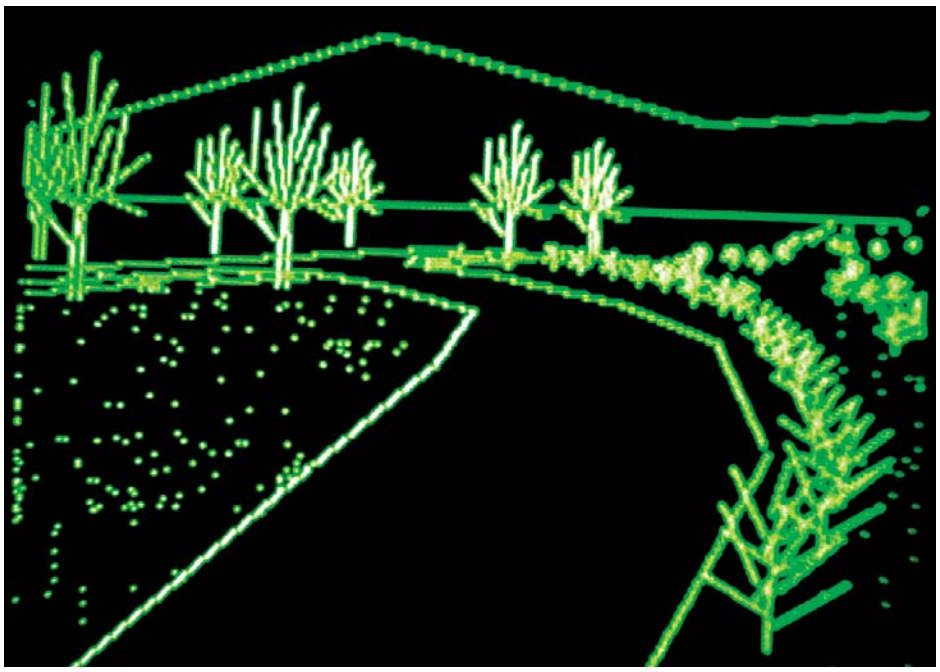
Dr. Stephen Ervin

Dr. Stephen Ervin is as vibrant as his day of birth—Mardi Gras. Like the celebratory day itself, Ervin is larger than life and full of contagious energy. He has spent two decades working at Harvard University teaching courses, speaking at conferences, and authoring books—mostly about his passion: the intersection of computing, design, and science. "Geodesign has taken over my life," Ervin chuckles.

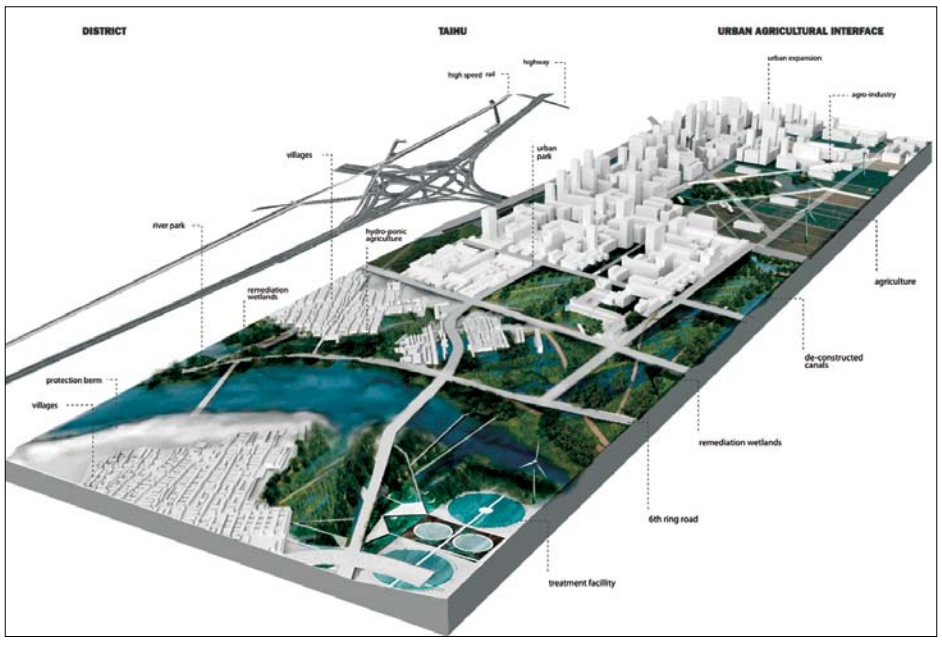
The assistant dean for information technology at Harvard Design School and director of computer resources and lecturer in the Department of Landscape Architecture, Ervin somehow manages to find time to evangelize and promote the principles of geodesign in various ways around the world.

"When I first heard the term, I thought I'd been using it all my life," says Ervin. "But I hadn't. What is geodesign? Well, to me, it is the fusing of imaginative and functional creativity in environmental design and planning, with analytic geospatial science, informing design with simulations, impact analyses, and systems thinking—all of it enabled by modern digital technology and collaboration tools."

Ervin stops and grins. "That's a big mouthful, but what it really means is that we finally have the means to go about geodesign with all this digital technology. There was no geodesign 50 years ago. Now we have computers, software, satellites, collaboration tools, apps, and smartphones—we have a whole new discipline on our hands."



"Digital Landscape," circa 1982 by Stephen Ervin on an Apple II computer.



"Urban Agricultural Interface, Taihu District (Beijing)," by Harvard Graduate School of Design students Fadi Masoud, Andreas Viglakis, and Cameron Barradale from Geodesign Studio cotaught by professors Yu, Ervin, Mulligan, and Rowe, 2011.

Geodesign Is Just in Time

Ervin has taken his thoughts and ideas on geodesign and applied them to urban planning projects around the world, including the sustainable expansion of Beijing, China. Ervin has taken on the study of the peri-urban districts located around Beijing with former student and successful Chinese landscape architect Yu Kongjian. "One of the great advantages of being an academic, of course, is having students who go on to vastly exceed your own performance and various accomplishments," says Ervin.

The peri-urban fringes of metropolitan areas like Beijing are a fertile laboratory for new experiments in integrated land use, transportation, energy, housing, and related developments, says Ervin. The work that he and his Harvard and Peking University colleagues have been taking on for the last three years is hoped to go far in transforming both the practice of landscape architecture and the very continent of China. From singular projects to creating a plan for the ecological security of the entire country to introducing a Pan-Asian geodesign conference to take place in the future, Ervin has high expectations.

"Urbanization, transportation, pollution, health, housing—all sorts of related problems urgently need to be addressed," says Ervin. "Geodesign, in my view, is just in time. We need it. We have big problems. The kinds of complicated issues in the world, on the planet, whether they're transportation or housing or energy or any of them—we need the combined power of collaboration, imagination, and computation to address these issues. Design holds an important half—science, the other half. Their fusion is geodesign."

A Holistic Approach to Plural Processes

In Ervin's opinion, geodesign is something that has been talked about for many years. "We called it computer-aided design," says Ervin. "We didn't mean CAD—we meant design aided by computation, and that's really where we are headed."

One of the defining moments in Ervin's career was reading a book authored by California landscape architect Larry Halprin entitled *The RSVP Cycles: Creative Processes in the Human Environment*. The concept of plural processes caught his attention. "There is no singular creative process," says Ervin. "There are many of them—just as there are many geospatial operations. And the geodesign challenge is to find how and when to combine them."

What changed his way of thinking drastically was a map at the end of the book. The map had recognizable coastline and forests, but it was also a sort of diagram containing concepts and ideas. "I thought, 'Wow, that's a fabulous combination of kinds of representations combining types of cognitive processes that really characterize design,'" says Ervin. "I've thought about this many times since, that representation is key—both abstract and conceptual on the one hand and concrete and specific on the other. Both are part of what we have to consider during the design process."

From Bits of Bytes to GIS

Another defining moment—studying in the graduate school landscape architecture program at the University of Massachusetts in Amherst—introduced Ervin to computer representations of the real world. "I saw this image of ski slopes cut into the hills and the forest clearing that were quite primitive graphically; at that time, trees were little triangles with sticks," says Ervin. "It probably cost days and thousands of dollars for the US Forest Service to produce back in the 1970s. But what I was drawn to was this idea that this took bits and bytes and tabular data about tree positions and species and an elevation model and turned it into a visual representation from which decisions could be made—too much clearing, or not enough clearing, or a little more to the right or left."

The idea that tabular, quantitative data could be combined with qualitative, impressionistic representations was inspirational to Ervin. From here, he discovered synthetic landscapes derived completely by computer programming. "The idea that a natural world could be captured inside of data structures and algorithmic processes really grabbed me," says Ervin.

He bought the most powerful computer he could afford—a Macintosh Apple II—and wrote his own perspective graphics program using a 200 x 300 pixel display. He presented his work at the Laboratory for Computer Graphics and Spatial Analysis at Harvard University where he was introduced to GIS. In 1984, Ervin took this knowledge and began a software company to help landscape architects visualize the results of design decisions.

Four Key Aspects of Geodesign

When Ervin went to teach landscape architecture at Harvard University in the graduate school of design, he felt privileged to work with his friend, colleague, and mentor, Dr. Carl Steinitz, whose course, Theories and Methods of Landscape Planning, was a mainstay for the Harvard curriculum—and whose book, *A Framework for Geodesign*, has recently been published by Esri Press. For the last 20 years, Ervin, Steinitz, and others, have worked to create and improve a framework fundamental to design processes.

Ervin presented 50 predictions about the future of geodesign at Esri's Geodesign Summit in January 2012. Among these, he considers four to be most important:

- *Geodesign is all about water*, its purity and availability and the right of every human being to have access to it. Understanding hydrology—how to both prevent dangerous flooding and preserve valuable freshwater resources—is key to every project that people take on and to the future of the planet.
- *Projects will depend on not just data and analysis but also dynamic simulations of processes*. It is through these simulations that designers can begin to see the real impacts of their design decisions.
- *Software for geodesign is going to explode*. From crowdsourced data to remotely sensed data to applications and devices, the industry is a virtual tsunami of innovative ideas coming to fruition.
- *Systems thinking will be required for geodesign projects*. Recognizing that the planet is made up of systems with interacting parts and that everything is connected to everything is important. It's the interaction of the individual components that are key but least understood.

The marriage of science and design is the real challenge to geodesign, so interactions may be orchestrated, and we can see the true impacts of design decisions. The idea that people can have visual feedback for making decisions—such as with the ski slope representations—has become a fundamental driver to what Ervin finds the most exciting about geodesign. "The idea of immediate visual feedback and dashboards to display key indicators that tell us how well we're doing, and in real time, is important," says Ervin. "Whether measuring carbon footprint or total costs or total number of houses, cars, people, buses, or even elephants—it's important to have this kind of feedback and in real time."

For more information, contact Stephen Ervin (e-mail: servin@gsd.harvard.edu).

The 50th Anniversary of GIS

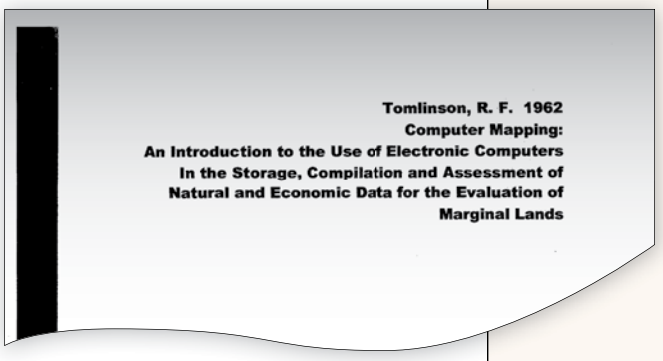
Roger Tomlinson

Some events, like birthdays, weddings, and graduations, are easy to mark on the calendar. Others, like the beginning of a social movement or a language—or the invention of GIS—are harder to pinpoint. However, the confluence of three pivotal events in 1962 and 1963 makes this as good a time as any to celebrate a half-century of GIS.

The first event was the establishment of the Canada Land Inventory (CLI) in 1962. CLI set out to produce about 1,500 maps of land use and land capabilities at 1:50,000 and 1:250,000 scales. Though the maps were made by traditional manual methods, Roger Tomlinson (then employed by Spartan Air Services of Ottawa) convinced the head of CLI that computers could be used to automate map analysis. CLI invited Tomlinson to define the functional requirements of what would later be called the Canada Geographic Information System. His carefully considered use of the qualifier "geographic" caught on and has created opportunities and challenges for the discipline of geography ever since.

In August 1963, just as Tomlinson delivered his feasibility report to CLI, Edward Horwood of the University of Washington organized the First Annual Conference on Urban Planning Information Systems and Programs. Within a few years, that event became the annual conference of a new organization called the Urban and Regional Information Systems Association (URISA). Urban and Regional Information Systems eventually became known as geographic information systems, and the 50th annual URISA conference—now called GIS-Pro—took place in 2012.

Horwood spent most of a month at Northwestern University in 1963 teaching a short course about computer handling and mapping of census data. One participant in that course was Howard Fisher, an architect who taught planning and design at Northwestern. Fisher was inspired to develop his own computer mapping system and, with the help of programmer Betty Benson, soon developed a working prototype called SYMAP. With a grant from the Ford Foundation, Fisher later founded the Laboratory for Computer Graphics at Harvard, where he oversaw an important strand of the evolution of computer mapping into GIS.



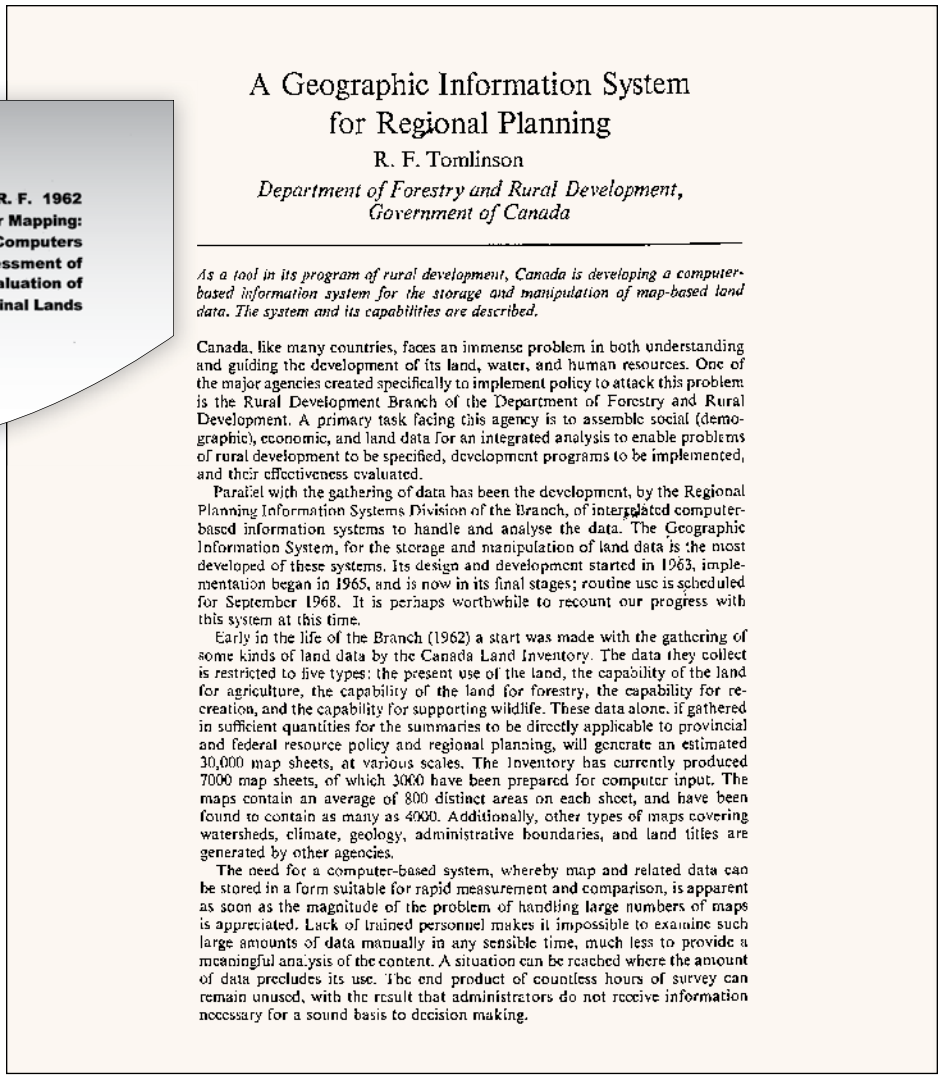
Tomlinson, R. F. 1962
Computer Mapping:
An Introduction to the Use of Electronic Computers
In the Storage, Compilation and Assessment of
Natural and Economic Data for the Evaluation of
Marginal Lands

The title page of Roger Tomlinson's 1962 paper that started the work on GIS in the Government of Canada.

Whether we choose these milestones or others as the origins of GIS, the fact remains that GIS has come a long way, baby, in a relatively short period of time. Its impact extends far beyond the hundreds of thousands of GIS professionals at work around the world. The recent Penn State-Public Broadcasting video series *Geospatial Revolution* (**geospatialrevolution.psu.edu**) dramatizes the far-reaching impacts of GIS and related technologies on how we think, act, and interact. At its 50th anniversary, GIS has itself become a kind of movement and a kind of language.

Original Documents

Digital copies of Roger Tomlinson's original feasibility report and related documents are available (by kind permission of the author) in the *ArcNews* Online version of this article (**esri.com/arcnews**).



A Geographic Information System
for Regional Planning

R. F. Tomlinson

Department of Forestry and Rural Development, Government of Canada

As a tool in its program of rural development, Canada is developing a computer-based information system for the storage and manipulation of map-based land data. The system and its capabilities are described.

Canada, like many countries, faces an immense problem in both understanding and guiding the development of its land, water, and human resources. One of the major agencies created specifically to implement policy to attack this problem is the Rural Development Branch of the Department of Forestry and Rural Development. A primary task facing this agency is to assemble social (demographic), economic, and land data for an integrated analysis to enable problems of rural development to be specified, development programs to be implemented, and their effectiveness evaluated.

Parallel with the gathering of data has been the development, by the Regional Planning Information Systems Division of the Branch, of integrated computer-based information systems to handle and analyse the data. The Geographic Information System, for the storage and manipulation of land data is the most developed of these systems. Its design and development started in 1963, implementation began in 1965, and is now in its final stages; routine use is scheduled for September 1968. It is perhaps worthwhile to recount our progress with this system at this time.

Early in the life of the Branch (1962) a start was made with the gathering of some kinds of land data by the Canada Land Inventory. The data they collect is restricted to five types: the present use of the land, the capability of the land for agriculture, the capability of the land for forestry, the capability for recreation, and the capability for supporting wildlife. These data alone, if gathered in sufficient quantities for the summaries to be directly applicable to provincial and federal resource policy and regional planning, will generate an estimated 30,000 map sheets, at various scales. The Inventory has currently produced 7000 map sheets, of which 3000 have been prepared for computer input. The maps contain an average of 800 distinct areas on each sheet, and have been found to contain as many as 4000. Additionally, other types of maps covering watersheds, climate, geology, administrative boundaries, and land titles are generated by other agencies.

The need for a computer-based system, whereby map and related data can be stored in a form suitable for rapid measurement and comparison, is apparent as soon as the magnitude of the problem of handling large numbers of maps is appreciated. Lack of trained personnel makes it impossible to examine such large amounts of data manually in any sensible time, much less to provide a meaningful analysis of the content. A situation can be reached where the amount of data precludes its use. The end product of countless hours of survey can remain unused, with the result that administrators do not receive information necessary for a sound basis to decision making.

The first known published use of the term *Geographic Information System* in August 1968.

For more information, contact David DiBiase, director of education, industry solutions, Esri (e-mail: ddibiase@esri.com).

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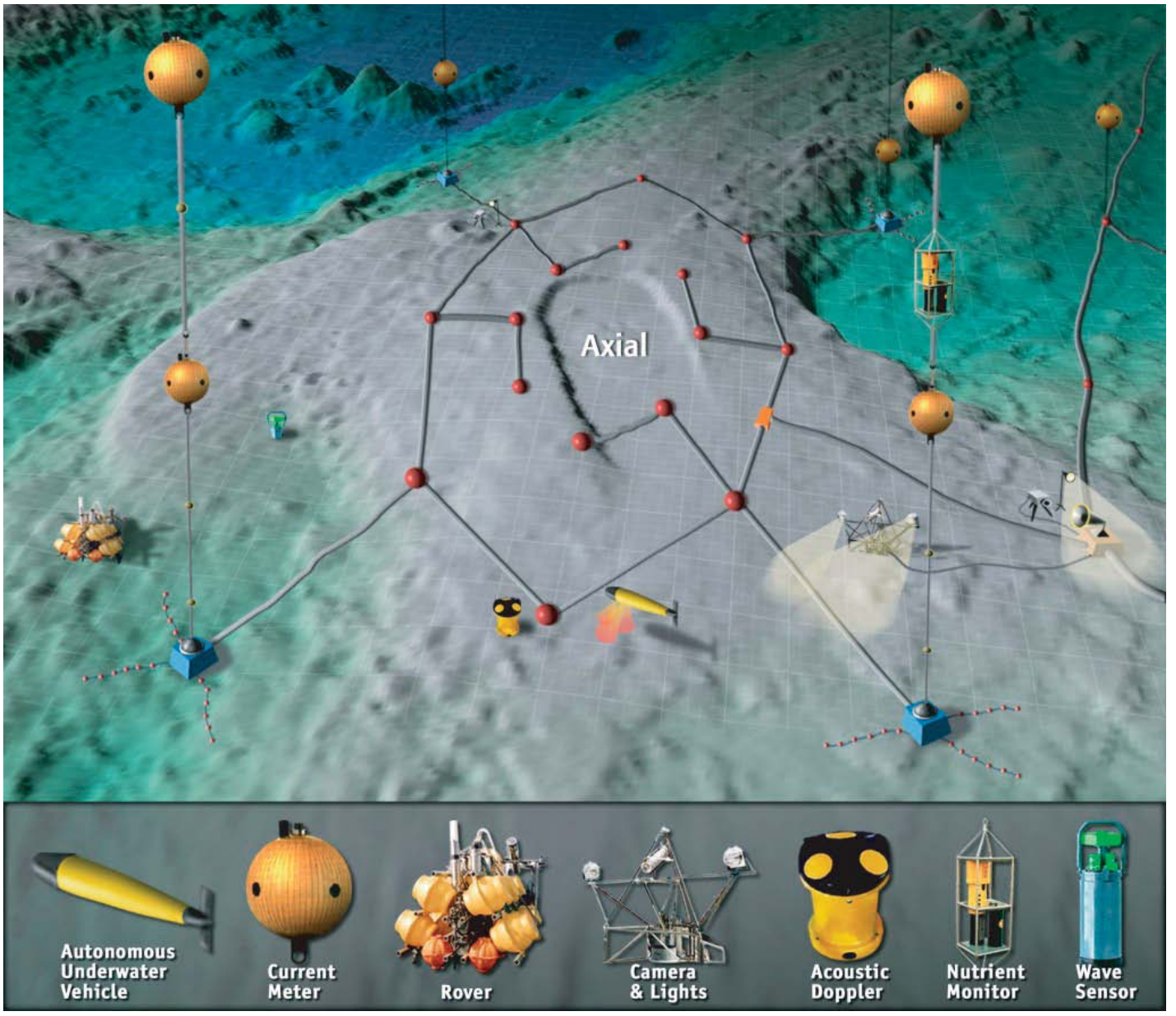
A Commitment to Understanding Our Oceans

Esri's Ocean GIS Initiative

By Dr. Dawn Wright, Esri Chief Scientist

On a planet where 71 percent of the surface is covered by water, the oceans are critical for life itself. They feed us, regulate our weather patterns, provide over half the oxygen that we breathe, and provide for our energy and economy. Yet only 5 to 10 percent of the ocean floor and the waters beneath the surface have been explored and mapped in a level of detail similar to what already exists for the dark side of the moon, for Mars, and for Venus.

GIS technology, which has long provided effective solutions to the integration, visualization, and analysis of information about land, is now being similarly applied to oceans. Our ability to measure change in the oceans (including open ocean, nearshore, and coast) is increasing not only because of improved measuring devices and scientific techniques but also because new GIS technology is aiding us in better understanding this dynamic environment. This domain has progressed from applications that merely collect and display data to complex simulation, modeling, and the development of new research methods and concepts.



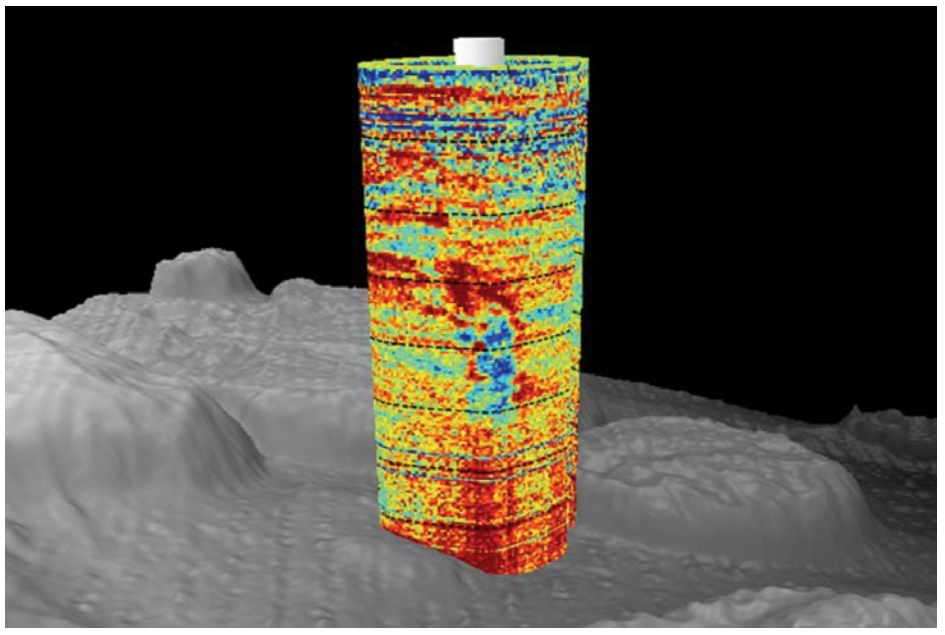
Our ability to measure change in the oceans is increasing because of improved measuring devices and scientific techniques, as well as new GIS technology.

The Ocean GIS Initiative

As an organization with the mission to inspire and enable people to positively impact their future through a deeper, geographic understanding of the changing world around them, Esri recognizes that this understanding must involve a strong commitment to the oceans. And that's why Esri recently launched a major Ocean GIS initiative across the entire company. The team supporting this initiative is composed of professional services staff, GIS software engineers, project managers, instructors, Partners, and many others.

The Ocean GIS initiative has been motivated in great part by the need to provide effective mapping tools and techniques to respond to recent disasters such as the Deepwater Horizon oil spill in the Gulf of Mexico and the Tohoku-Oki earthquake and tsunami in Japan. It is also motivated by a sincere desire to assist in the implementation of the United States National Ocean Policy, particularly in the area of coastal and marine spatial planning, for which GIS provides a crucial decision support engine.

As part of this initiative, Esri is expanding from an initial emphasis on nautical chart production and applications for commercial shipping, maritime defense/intelligence, and offshore energy (e.g., oil and gas, wind energy) to ocean science and resource management. Esri is pursuing a greater engagement with the ocean science community, as complex ocean science questions and data are increasingly used to inform the responsible use and governance of the oceans, as well as effective management and conservation.



The water column over the Deepwater Horizon oil spill in the Gulf of Mexico showing acoustic backscatter data over the wellhead. The visualization was produced by the University of New Hampshire Center for Coastal and Ocean Mapping (UNH-CCOM) using the Fledermaus midwater mapping tool (courtesy of ccom.unh.edu/project/deepwater-horizon).

To support a better understanding of our oceans, Esri is focused on improving and expanding its products, tools, services, partnerships, and connections with the broader ocean community. Some of the initiatives being pursued toward this goal are outlined below.

Grow the Ocean Basemap

Esri will continue to build the bathymetry data asset in the Ocean Basemap via crowdsourcing, with a continued strong emphasis on authoritative contributions from international hydrographic offices and scientific institutions. It will also explore and implement the provision of additional public domain content layers, such as existing nautical chart services with International Hydrographic Organization S-57 symbology, and global maritime boundaries, offshore energy infrastructure, sea surface temperature, salinity, sediment classifications, acoustic backscatter, and more. Esri will also continue to make progress on a version of the basemap without labels.

Build a More Integrated Elevation Service

Esri will expose the Ocean Basemap as part of the World Elevation Service, making it a truly integrated "land and ocean" elevation service. This includes building in the potential for raster analytics performed against the bathymetry and other valuable ways to expose the data.

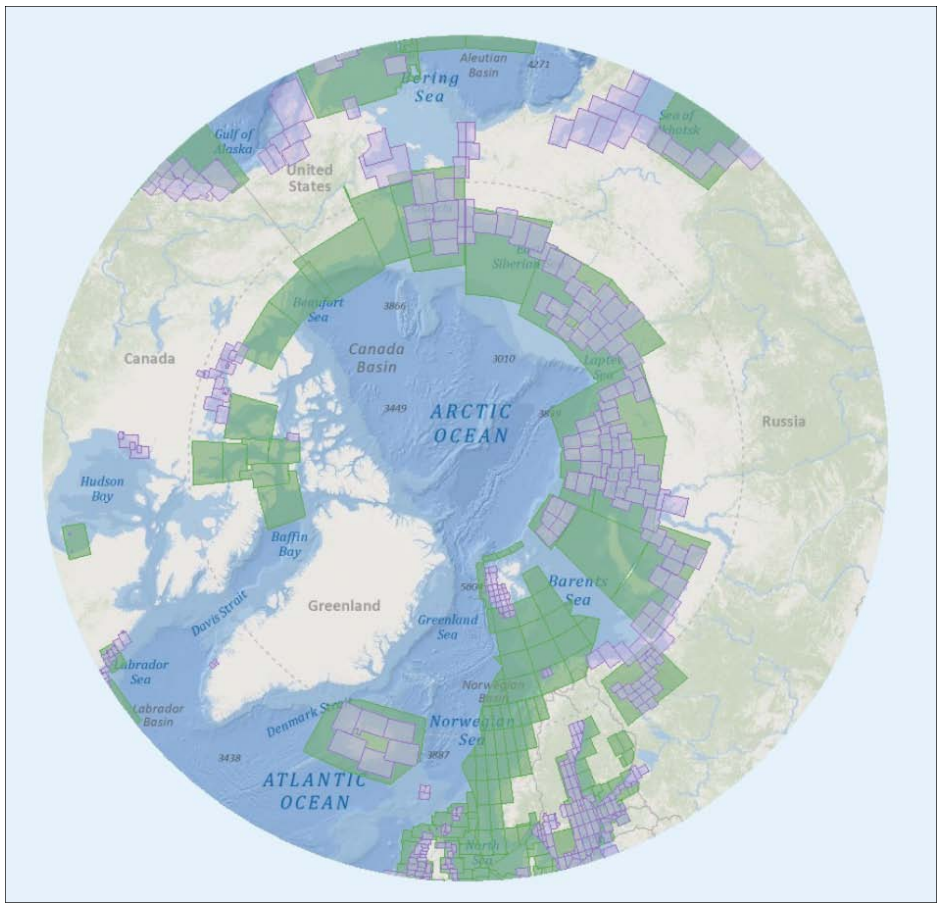
Provide Intelligent Bathymetry in the Cloud

Esri's goal is to provide intelligent bathymetric services in the cloud by underpinning the Ocean Basemap with the power of ArcGIS for Maritime: Bathymetry and the bathymetric information system (BIS) therein. A BIS server would push out additional management functions for bathymetry, such as database rules to sequence and display data by highest resolution, acquisition date, and so forth, as well as have the benefit of faster performance. This capability would allow the Ocean Basemap to deploy, in the cloud, a truly worldwide model of bathymetry.

Establish ArcGIS Resource Centers for Oceans and Maritime

The ArcGIS Resource Center has been reorganized and updated in conjunction with the release of ArcGIS 10.1, and final versions of an ArcGIS for Oceans and an ArcGIS for Maritime resource center are now completed. Work continues on populating these resource centers with additional content under the themes of Research and Exploration, Ocean Observation, Marine Ecosystems, Aquaculture and Fisheries, and Recreation and Adventure.

Esri is also developing an advisory group of key customers to assist with guiding the growth and further development of the ArcGIS for



The Ocean Basemap displayed in polar projection as part of an Esri Story Map. This shows the extent of the Arctic yet to be covered by nautical charts. The footprint of existing nautical charts is in green and purple.

Ocean Use Planning section within the Oceans and Maritime resource centers. Current development projects in this arena include the following:

- The addition of economic data and demographic data services, giving all ocean use planning applications the ability to tie impacts to economy or onshore populations
- Development of fisheries management content and resources
- Development of conservation and protection resources

Convene an Oceans Summit

The Esri Oceans Summit, to be held November 7–8, 2012, is a primary means of advancing Esri's Ocean GIS initiative. This high-level strategy meeting will be attended by a select group of intermediate to advanced ocean GIS analysts and developers. A successful event will potentially lead to an annual Esri Oceans Summit, open to all users, which will serve further to establish an Esri oceans user community with a shared vision of advancing the implementation of GIS in ocean science and resource management.

Update and Support the Arc Marine Data Model

The Arc Marine data model, first published in a research monograph in 2007, has been widely adopted by agencies and organizations responsible for our oceans. It is still recognized as a valuable model, and its adoption appears to be ongoing, with a number of organizations seeking to standardize on Arc Marine. A new plan is being developed to implement the data model in the latest version of the Esri geodatabase (including the ability to use a file rather than just a personal geodatabase), as well as best practices to define a web service platform. It will be newly validated against use cases and cartographic and user requirements. A new tutorial will be prepared to incorporate a broader range of ocean datasets and possible workflows with the model.

Develop Vertical, Time-Dependent Data Transformations

In collaboration with the National Oceanic and Atmospheric Administration, Scripps Institution of Oceanography, and the US Geological Survey, Esri is developing a series of vertical, time-dependent datum transformations to help researchers transform data between ellipsoidal, orthometric, and tidally referenced elevation data at the shoreline. This is absolutely critical for coastal surveying, coastal geomorphology, and coastal terrain models that connect nearshore bathymetry for terrestrial digital elevation models that are used for storm surge, hurricane, and tsunami inundation modeling.

Improve Support for Multidimensional Data and Analyses

Satellites can clearly map the ocean surface, and acoustic sensors can map the ocean floor, but ocean scientists currently have a limited view of the water column between the ocean surface and the ocean floor. There is a critical need to study the internal structure of features in the water column, such as plumes (hydrothermal vent plumes and oil well plumes as in the Gulf of Mexico spill) or schools of fish to obtain fish stock dynamics, spawning grounds, seasonal habitats, and the impact of climate change on these. To exploit water column data, an efficient means of reading, processing, and analyzing the data is required.

Esri is continually improving support for scientific spatial and temporal data formats, such as the climate forecast convention of the Network Common Data Form 4 (netCDF-4) data model and the closely related Hierarchical Data Format. In addition, Esri seeks to better articulate to users the rich palette of 3D representation that ArcGIS already contains, such as features, TINs, vectors, multipatches, and arrays.

Esri will be adding more 3D analytics in the next generation of ArcGIS, enhancing all 3D representations to deal with the visualization and interpretation of scientific data, imagery features, point clouds, and arrays. This is particularly important in Esri's quest to improve software functionality for ocean and atmospheric GIS.

Support Ocean Numerical Models

Building a GIS platform that various kinds of numerical modelers could use to associate their efforts would provide a kind of geospatial fabric to interrelate the models. One of the most widely used models in the oceans space is the Regional Ocean Modeling System (ROMS), yet models such as ROMS pose great challenges for GIS, as they are often not uniformly spaced and may be composed of either unstructured triangles or structured curvilinear grids. There is a great need for tools to handle these grids in a more standardized way, allowing the possibility of standard access to data on the model's native grid. To address this important issue, Esri is investigating the use of netCDF Markup Language, an XML representation of netCDF metadata, which contains attributes that work effectively with the third dimension.

For more information about Esri's Ocean GIS initiative, download the e-book at **esri.com/library/ebooks/ocean-gis-initiative.pdf**.

Sustainability in Africa

By Peter A. Seligmann and Sandy J. Andelman, Conservation International

NGO Non-Governmental Organization

"We need to take stock and attach value to our natural resources and ecosystems, such that we may include their value in planning and decision-making processes, as well as in our national accounts and balance sheets."

Although His Excellency President Ian Khama of Botswana was speaking about Africa in his opening remarks to the first Summit for Sustainability in Africa, his words apply equally to the rest of the globe.

The goal of the summit, hosted in Gaborone last May by the government of Botswana and Conservation International, was to demonstrate how African nations and their investment partners understand, manage, and value natural capital to support and improve human well-being. The aim was to take a practical, results-focused approach, with African nations leading and encouraging investment partners to provide support in a coordinated and coherent fashion.

The term *natural capital* refers to earth's natural assets (soil, air, water, plants, and animals) and the ecosystem services resulting from them (e.g., food production, climate regulation, pollination, flood protection) that sustain human life.

The visionary heads of state and ministers of 10 African nations—Botswana, Gabon, Ghana, Kenya, Liberia, Mozambique, Namibia, Rwanda, South Africa, and Tanzania—unanimously voiced their support for the value of natural capital in national accounting. These nations reached two key conclusions. First, there was unanimous consensus that the historical pattern of resource exploitation has failed to promote sustained growth, environmental integrity, and improved social capital and has, even worse, been counterproductive. Second, they agreed that the value of natural capital—the wealth of benefits provided to people by biodiversity and ecosystems, like watersheds, forests, coral reefs, and grasslands—must be fully accounted for and integrated into national and corporate planning, as well as reporting practices, policies, and programs.

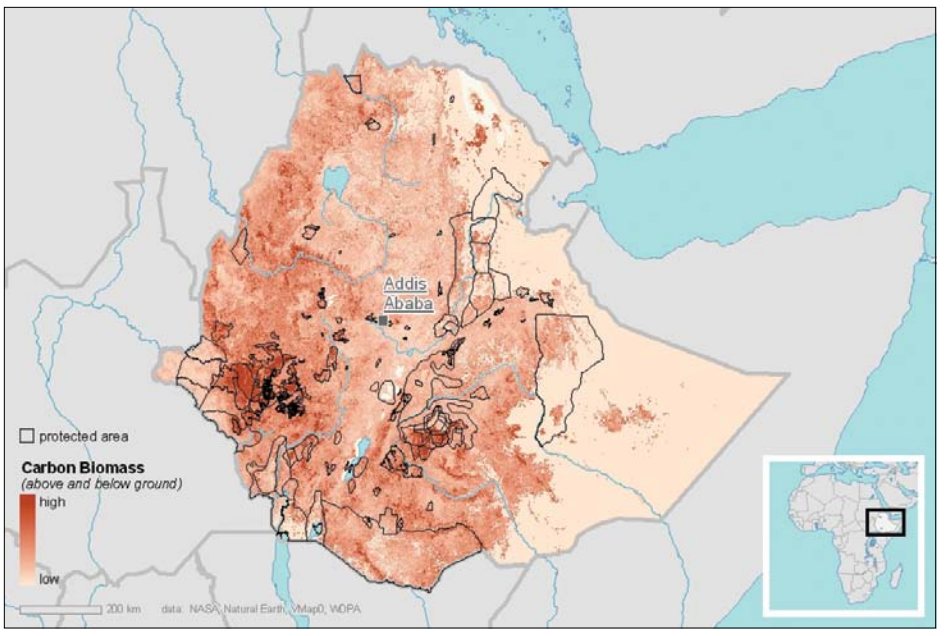
The message resulting from the summit—the Gaborone Declaration (**www.conservation.org/ssa**)—reaffirmed a commitment to sustainability already shared by these visionary leaders. The declaration signaled a new era of leadership, rooted in Africa, that understands, values, and manages the natural capital that sustains all of us: a platform on which we can begin to build a sustainable future.

Summit participants included Sam Dryden, director of agricultural development at the Bill & Melinda Gates Foundation; Laurene Powell Jobs, chair and founder of Emerson Collective; Rachel Kyte, vice president of sustainable development at the World Bank; Rob Walton, the chairman of Walmart; and numerous other private- and public-sector partners from within and outside Africa. These participants also issued a communiqué to draw attention to what they described as "the limitations of GDP [gross domestic product] as a measure of well-being and sustainable growth that values environmental and social aspects of progress."

In closing the summit, President Khama emphasized the importance of following through on these commitments. "This meeting will not be of any value to our peoples if we fail to achieve the objectives that formed the core of this summit, that is, integrating the value of natural capital into national and corporate accounting and planning," he said. "We must continue building social capital and reducing poverty by transitioning agriculture and extractive industries to practices that promote sustainable employment and the protection of natural capital while building the knowledge, capacity, and policy networks needed to promote leadership and increase momentum for change."

This is true leadership and an example we should celebrate and follow.

The Gaborone Declaration marked an important step in paving the way toward mutually beneficial partnerships between governments and businesses. A month later, at Rio+20—the United Nations Conference on Sustainable Development—these 10 African nations united under the Gaborone Declaration and emerged as global leaders. They urged others to join them in taking the first steps to correct what has been, up until now, a misguided development trajectory. They were followed by 49 other nations, developed and developing alike, along with nearly 100 public, private, and civil society partners, including ArcelorMittal, the Coca-Cola Company, the Bill & Melinda Gates Foundation, the German Development Institute, the MacArthur Foundation, the United Nations Environment Programme, the United Nations Permanent Forum on Indigenous Issues, Walmart, Woolworths, the World Bank, and World Vision.



This map was part of a series created for the first Summit for Sustainability in Africa, held in Gaborone in May 2012 to demonstrate the natural capital of participating countries. In this example, the ecosystem service of climate regulation through carbon storage is shown, along with the country's protected area network.

Measuring Sustainability: Getting the Metrics and Measurements Right

The recent Stiglitz-Sen-Fitoussi Commission on the Measurement of Economic Performance and Social Progress (2009) put it very clearly:

> What we measure affects what we do; and if our measurements are flawed, decisions may be distorted. . . . Those attempting to guide the economy and our societies are like pilots trying to steer a course without a reliable compass. The decisions they make depend on what we measure, how good our measurements are and how well our measures are understood. We are almost blind when the metrics on which action is based are ill-designed or when they are not well understood. . . . We need better metrics.

Ecosystem goods and services from natural capital provide an enormous contribution to the global economy, but natural capital has not been factored into conventional indicators of economic progress and human well-being like GDP or the human development index (HDI). Neither GDP per capita nor the HDI reflect the state of the natural environment. Both indicators focus only on the short term, giving no indication of whether current well-being can be sustained for future generations.

Many economists and politicians have become convinced that the failure of societies to account for the value of natural capital—as well as the use of indicators of well-being that don't reflect the state of natural capital—have contributed to degradation of the natural environment. We are using a flawed measurement approach to guide policy and decision making, and one key step toward achieving healthy, sustainable economies is to begin accounting for our use of natural capital. We must recognize and report the true cost of economic growth and our ability to sustain human well-being, both today and in the future. By incorporating the value of natural capital and ecosystem services, such as water provision, climate regulation, soil fertilization, or plant pollination, into our balance sheets, governments and businesses will be able to see a more holistic and accurate picture of natural and national wealth.

Sustainability and Food Security: Grow Africa and the G8 New Alliance for Food Security and Nutrition

Ann's story that follows is representative of hundreds of millions of farmers across sub-Saharan Africa. The continent's smallholder agricultural systems have inadvertently degraded vital ecosystem services like flood protection, water supply, and soil nutrient cycling:

Ann is 75 years old, a feisty grandmother in Wasare, Kenya, near Lake Victoria. She remembers five decades ago as a fish trader, when the water was clear, fish were abundant, the hilltops were green and lush, and harvests were plentiful. Now, she barely ekes out a living on her family farm. Like all her neighbors', Ann's field is planted with corn, but the soil underneath the rows of corn is gravely wounded and pale, drained of vital minerals. Gulleys scar the landscape, evidence of sustained hemorrhaging of fertile soils.

According to Jon Foley of the University of Minnesota, feeding the growing world population in the next 40 years will require producing as much food as we have produced in the last 8,000 years. This equates to a 70–100 percent increase in food production through agricultural intensification and expansion, mainly in developing countries. In this context, Africa is central to solving the world's food security and sustainability challenges. Africa contains 12 percent of the globe's land that is suitable for agriculture, but only 33 percent of this land currently is cultivated. Africa also offers significant opportunities to increase production on existing agricultural lands by filling yield gaps (i.e., the difference between current crop yields in a given location and the potential yield for the same location) using improved agricultural management and new technologies.

Two other processes that focus on food security and involve many of the same governments and private-sector players are the World Economic Forum's Grow Africa Initiative and the G8 New Alliance for Food Security and Nutrition. These initiatives have been moving forward, largely independently of and parallel to the Summit for Sustainability in Africa and Rio+20, yet they underscore the importance and timeliness of the Gaborone Declaration.

Building on public-private partnership models piloted by the World Economic Forum's New Vision for Agriculture Initiative, Grow Africa is a public-private partnership platform. It aims to accelerate investments and transform African agriculture in accordance with national agricultural priorities and in support of the Comprehensive Africa Agriculture Development Programme, a program of the New Partnership for Africa's Development established by the African Union in 2003. At the Grow Africa Investment Forum last May, held at the glamorous African Union Conference

The Geospatial World of Conservation International

Armed with an Esri nonprofit organization site license, for many years Conservation International (CI) has partnered with Esri and Esri Partners and users to provide data and geospatial analysis that has made a world of difference. To name merely a few, CI uses ArcGIS for the following:

- As the core analytical engine for its automated near real-time monitoring systems, serving more than 1,200 subscribers in Madagascar, Indonesia, Bolivia, and Peru
- To analyze trade-offs between multiple ecosystem services and stakeholders linked to land use and water quality management in the Great Barrier Reef, Australia
- To define site- and landscape-level conservation priorities in collaboration with regional partners to guide conservation action and funding in the Mediterranean Basin, Caribbean, Eastern Afromontane, Indo-Burma, and East Melanesian Islands biodiversity hot spots
- To analyze land use and natural resources to inform various development scenarios in the Cardamom Mountains of Cambodia to guide government policy makers

For more information, contact Kellee Koenig, Conservation International (e-mail: k.koenig@conservation.org).

Centre in Addis Ababa, seven African governments presented opportunities for multinational, private-sector investment.

Also in May, at Camp David (the US president's retreat in Frederick County, Maryland), the G8 countries announced the New Alliance for Food Security and Nutrition. The New Alliance, also a public-private partnership, is being promoted as a mechanism to raise 50 million people in Africa out of poverty over the next 10 years. The G8 committed $1 billion, together with $3 billion in pledges from 45 agribusiness companies, and is initially targeting Ethiopia, Ghana, and Tanzania. While applauding the focus on lifting 50 million people out of poverty, several African civil society groups and international organizations, such as the agency Oxfam, have criticized the alliance's top-down approach and its failure to bring smallholder farmers—particularly women—to the table. They have also voiced concern about its lack of attention to environmental sustainability.

We are clearly gaining traction and attention on these critical challenges, but we need to integrate our efforts to strengthen our collective impact.

Looking Ahead to Increased Sustainability

As stated by Kenyan Alex Awiti, director of the East African Institute at Aga Khan University in Nairobi, "A fundamental question underlies Africa's socioeconomic and environmental sustainability: How can smallholder farmers increase land productivity, profitability, and human well-being outcomes without causing irreparable damage to the natural world on which they depend?"

Africa's smallholder production systems, like global agricultural production systems, depend on essential natural capital—the ecosystem services produced by ecosystems at many spatial scales, such as rainfall and water captured by forests or from underground aquifers or vegetation from grasslands and savannas to feed cattle, goats, and sheep. As a result, solutions to the challenges faced by smallholder farmers require a landscape-level approach.

However, much of the existing knowledge of ecosystems and agricultural systems in Africa is local, fragmented, often inaccessible, and seldom mapped at the scales relevant for decision making. As a result, policy makers, farmers, and investors often make important land-use and land management decisions based on partial and incomplete understanding of landscape-level interactions and feedback.

The harvesting of amaranth greens. (Photo courtesy of Conservation International. Copyright © Benjamin Drummond.)

Without concerted investments in a framework with the right metrics, indicators, and data to track changes in ecosystem services and human well-being, gains in food production are unlikely to be sustainable in the long run. At worst, they may unintentionally degrade the environment.

Conservation International and partners have argued, therefore, for a new, holistic, evidence-based approach to supporting African agriculture, one that improves decisions on sustainable land use and land management and provides a holistic understanding of ecosystem health and human well-being.

Africa needs an integrated diagnostic and monitoring framework to generate data and information at appropriate scales to support decision making at household, national policy, and international and global investment levels: an instruction manual, if you will, to ensure that communities, investors, growers, and decision makers are operating in sync. Such a framework requires a strategically selected set of indicators that integrate information about land productivity, soil and plant health, biodiversity, water availability, and human well-being in a scientifically credible way. At the same time, the set of indicators must be small enough that decision makers aren't overwhelmed with too much information.

Farmers like Ann, African governments, and investors like the G8 and multinational corporations need a system of metrics and indicators that provide information at the right scales. These indicators are the missing piece that will help minimize environmental impacts of food production, as well as ensure that the well-being of Ann and millions of farmers like her across sub-Saharan Africa can be improved in a sustainable manner.

Over the last two years, with funding from the Bill & Melinda Gates Foundation, Conservation International has worked together with a broad set of science and policy partners to identify the right set of metrics for measuring natural capital. These metrics are intended to map the flow of ecosystem goods and services to people and to quantify the contributions of these services to human well-being. We tested this framework in southern Tanzania, including the Southern Agricultural Growth Corridor of Tanzania (SAGCOT), where the country's government is attempting to transform agricultural development, increase food production, and reduce poverty through a targeted program of public-private partnerships. The corridor [see ArcGIS map on page 16] is critically important for maintaining natural capital and contains important protected areas that also provide revenue from ecotourism. As with Grow Africa, some questions and concerns are being raised with respect to SAGCOT: whether it is commercially viable, whether large commercial farms

continued on page 16

Sustainability in Africa

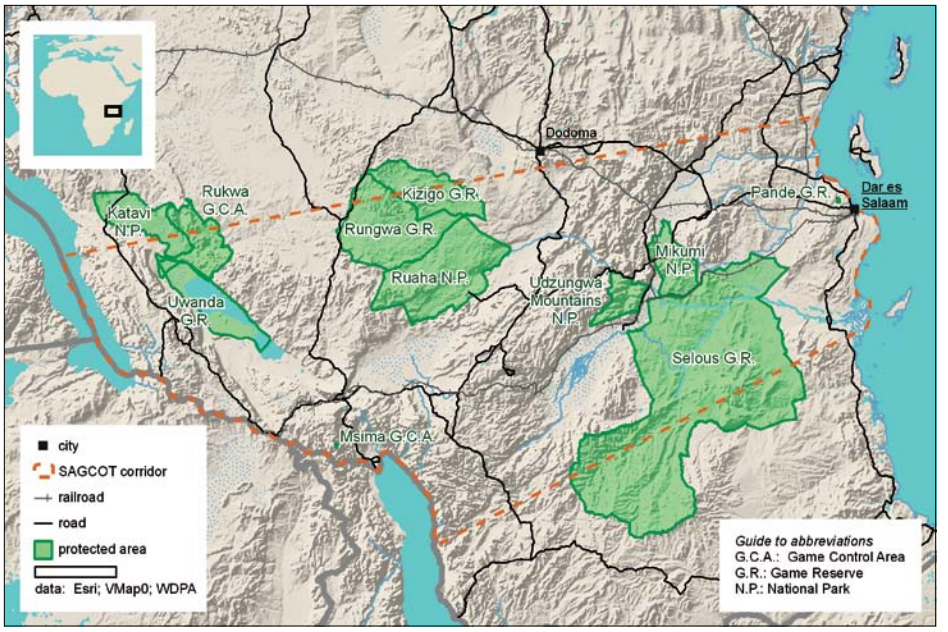
continued from page 15

will dominate the landscape at the expense of the region's poorest farmers, whether investments will be transparent, whether fears of land grabbing will be addressed, and whether there will be transparent processes for investments and auditing. Without access to integrated information on the socio-agroecosystems within the corridor—information that can gauge the success of the agricultural investments and the environmental and socioeconomic outcomes—there is significant risk that SAGCOT will fall short of its transformational goals.

Vital Signs Africa

Having identified the metrics and demonstrated the feasibility of making the necessary measurements at the right scales, we're ready to think bigger, act bigger, and dramatically scale up. Recently, Conservation International, in collaboration with Columbia University, the Council for Scientific and Industrial Research in South Africa, and the Earth Institute, launched Vital Signs Africa, an integrated monitoring system for agriculture, ecosystem services, and human well-being. The first phase of Vital Signs, funded by the Bill & Melinda Gates Foundation, focuses on regions in five countries in sub-Saharan Africa, including Ethiopia, Ghana, and Tanzania. These regions were selected because they are where agricultural transformation is targeted to meet the needs of Africa's growing population. Measurements will be collected through a combination of ground-based data collection, household surveys, and high-resolution and moderate-resolution remote sensing.

Currently, no African countries have environmental monitoring systems, and Vital Signs aims to fill that gap. The system emphasizes capacity building, working through subgrants to local scientists who will collect information and partnerships with existing data collection efforts, such as the Tanzania National Bureau of Statistics. It focuses on building local capacity for analysis and synthesis of spatial information, as well as on the capacity of African policy makers and institutions to understand and use this kind of information.



Map showing the Southern Agricultural Growth Corridor of Tanzania (SAGCOT), where the government is attempting to transform agricultural development, increase food production, and reduce poverty through a targeted program of public-private partnerships. The corridor is critically important for maintaining natural capital and contains important protected areas that also provide revenue from ecotourism.

Data collection will happen at multiple scales to create the most accurate possible picture: a household scale, using surveys on health, nutritional status, and household income and assets; a plot scale to assess agricultural production and determine what seeds go into the land, where they come from, what kind of fertilizer is used, what yield of crops they deliver, and what happens after the harvest; a landscape scale (100 km^2) measuring water availability for household and agricultural use, ecosystem biodiversity, soil health, carbon stocks, etc.; and a regional scale (~200,000 km^2) that will tie everything together into a big picture to enable decision makers to interact with the information at the scales on which agricultural development decisions are made. High-resolution (e.g., QuickBird, WorldView-2) and moderate-resolution (e.g., Landsat, SPOT) remote sensing will provide wall-to-wall coverage.

Vital Signs aims to fill the crucial information gap, providing a set of metrics to quantify the value of natural capital for agriculture and for human well-being; using the right measurements at the right scales; and offering a set of indicators and tools to provide policy makers, farmers, and investors with the holistic understanding they need for better decision making.

These are long-term endeavors that will take time to realize but offer a smarter way forward as we work to build healthy, sustainable economies that support people and our planet.

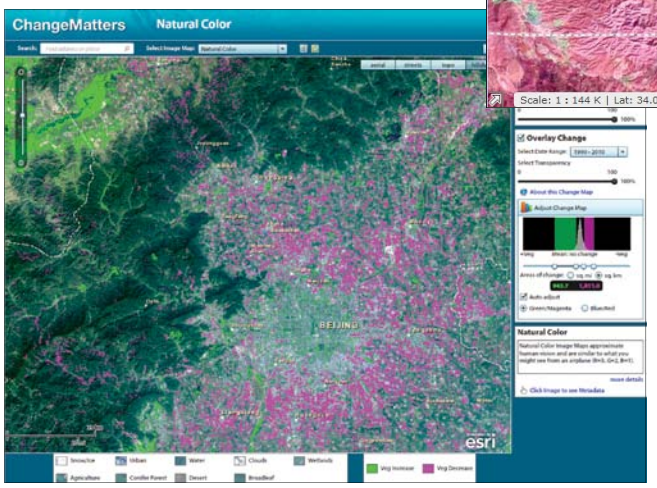
About the Authors

Peter A. Seligmann is chairman and chief executive officer of Conservation International and has been a leader in creating conservation solutions for the past 36 years. Since he founded the organization in 1987, Conservation International has earned a reputation as an organization on the cutting edge, creating innovative and lasting solutions to the threats facing humanity, biodiversity, and the natural systems that sustain us all. Dr. Sandy J. Andelman is the executive director of the Vital Signs Monitoring System and is a vice president at Conservation International. Vital Signs fills a critical unmet need for integrative, diagnostic data on agriculture, natural capital, and human well-being. Andelman has pioneered the creation of global monitoring and forecasting systems for climate change and ecological change.

For more information, contact Sandy Andelman, Conservation International (e-mail: s.andelman@conservation.org), and visit **conservation.org** or **vitalsigns.org**.

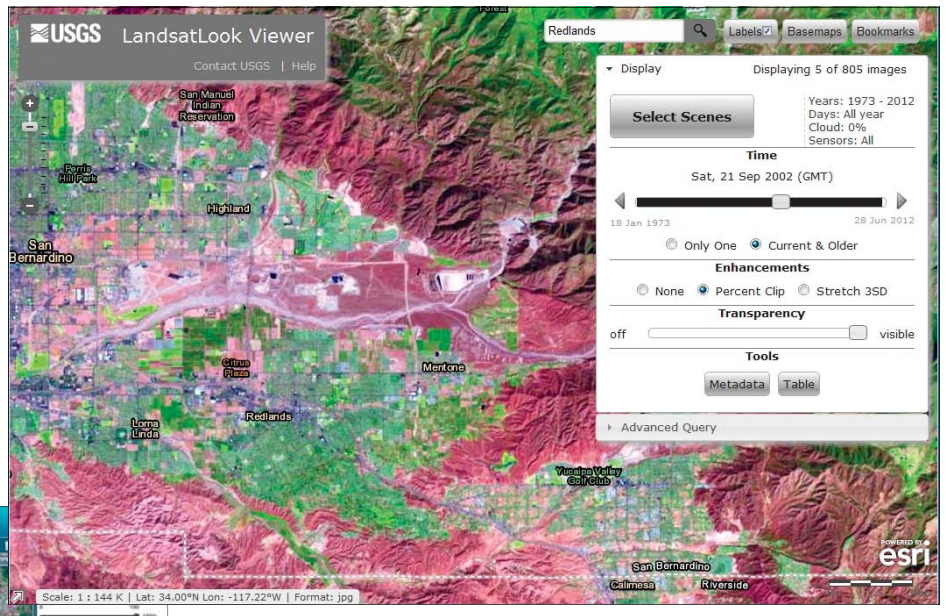
Understanding Earth Changes with Landsat Viewers

Landsat is the longest continuously running earth monitoring system, collecting millions of multitemporal, multispectral scenes covering the entire planet. July 23, 2012, marked the 40th anniversary of the first Landsat satellite launch, and Landsat data still remains the best way to understand global land cover, providing a window on earth changes. People use Landsat because it is more efficient than any other technology at meeting the same decision support requirements. Landsat data has grown significantly in value with each passing year and, since 2008, has been available free of charge from the United States Department of the Interior's US Geological Survey (USGS). Since that time, the use of Landsat has skyrocketed to more than eight million scenes.



The ChangeMatters Viewer shows vegetation changes in Beijing between the years 1975 and 2010.

When working with massive datasets, like Landsat, one of the obstacles encountered early on is how to make the data accessible to users in an easily digestible format. People working with Landsat want to be able to find the information they are looking for; extract the information; and move on to their work, which involves solving some of the most complex problems affecting our society today. There are two Landsat viewers available online that help users do just that—the LandsatLook Viewer from USGS and the ChangeMatters Viewer from Esri.



LandsatLook imagery of Redlands, California, from September 2002. The LandsatLook Viewer makes available more than 800 Landsat scenes covering the city ranging in date from 1973 to 2012.

Both of these viewers use ArcGIS technology to serve Landsat as web services, accessing many terabytes of imagery. Web services are one of the most common ways to share large datasets of information over the web, because users can easily access and analyze the information online from the web application and through other devices, platforms, and applications that can consume web services. This includes most smartphone and tablet devices, desktop applications, web applications, and ArcGIS products.

The USGS LandsatLook Viewer enables anyone to go anywhere and see how the world has changed in the last 40 years, with high temporal resolution. The LandsatLook Viewer provides access from any web browser to the complete archive of more than three million Landsat scenes. Using the LandsatLook Viewer, users can zoom to any location on earth and use a simple time slider to look through thousands of overlapping scenes for their area of interest, going all the way back to 1972. The LandsatLook data displayed is 30-meter resolution, three-band composite natural color images. Queries can be made to restrict scenes to specific date ranges, cloud cover, and sensors, and simple image enhancements can be applied to highlight features. The displayed images can be downloaded, and there is access to the full USGS Landsat scenes, if required. In the first two weeks, the LandsatLook viewer was visited by people from more than 90 countries. Get started with the USGS LandsatLook Viewer by going to landsatlook.usgs.gov.

The second viewer available on the web today is the Esri ChangeMatters Viewer. This is a powerful yet easy-to-use web application that provides simple access to the entire Landsat Global Land Survey (GLS). The GLS datasets are collections of the best cloud-free Landsat scenes from the five epochs, circa 1975, 1990, 2000, 2005, and 2010. The ChangeMatters Viewer uses ArcGIS as the underlying technology to additionally process the Landsat GLS dataset on the fly into multiple data products that are served as the World Landsat Services on ArcGIS Online. These web services make all the Landsat data quickly accessible with the ArcGIS Online server providing all the image processing. The ChangeMatters Viewer makes it easy to understand global earth changes in vegetation, urban growth, deforestation, natural disasters, etc. The ChangeMatters Viewer also includes a simple Normalized Difference Vegetation Index analysis that calculates the change difference in each pixel from one epoch to another. This is displayed on the screen in two shades, green and magenta, which represent vegetation increase and vegetation decrease, respectively.

An easy way to get started with the ChangeMatters Viewer is to watch the ChangeMatters Tips tour located on esri.com/landsat. This is a live, interactive tour that provides tips for using the ChangeMatters Viewer to understand the Landsat data. Esri has also applied the new ArcGIS 10.1 advanced imagery processing, correction, and enhancement tools to the web services used in the ChangeMatters Viewer. These new tools include the apparent reflectance function, which provides radiometric corrections to the displayed imagery; raster functions that can be applied to the 1975 epoch to simulate color views of the earth from the Landsat Multispectral Scanner series data by utilizing a virtual blue band; and the ability to automatically destripe scenes that contain the Scan Line Corrector problem, which resulted in data gaps.

Both the USGS LandsatLook Viewer and the Esri ChangeMatters Viewer are leveraging standard, commercial off-the-shelf ArcGIS products to serve massive volumes of Landsat imagery worldwide.

To learn more, go to esri.com/imagery.

US Capital's Parkland-to-Population Ratio Ranks High

Washington, DC, Completes Inventory of Federal Lands Within Its City Limits

Highlights

- The District of Columbia now has a centralized inventory of reservations.
- ArcGIS was the best tool for collecting, managing, and maintaining the city's spatial data.
- The data was captured using ArcGIS software's advanced editing tools.

Andrew Ellicott and Benjamin Banneker began surveying what would become Washington, DC, in 1791. From that time until today, there have been many land acquisitions and transfers between private citizens, the District of Columbia government, and the federal government. These transactions, over the course of 230 years, have established the federal government's land holdings inside Washington, DC. The majority of this public land is controlled and maintained by the United States National Park Service (NPS), is part of its park system, and comprises reservations. Some of the reservations, like Rock Creek Park, encompass thousands of acres, while others are as small as medians in the middle of roads.

The vast system of parks within Washington, DC, helps give the city its unique character.

This Dupont Circle is one of the traffic circles and federal parks that was part of Pierre L'Enfant's original plan of the City of Washington.

The Ellipse—with the White House and downtown Washington, DC, stretching out behind it—is one of the federal reservations. (Photo by Shutterstock.)

This triangle park is an example of one of the many smaller parks that are scattered throughout Washington. This park is created by Massachusetts Avenue running diagonally across a grid of north-to-south and east-to-west streets. (Photo by Bill Lescure.)

Nearly a quarter of Washington's land area is covered by parks, giving the city a less congested feel and creating an interesting blend of urban and natural landscapes. The city boasts the highest ratio of parkland to population in the country for a city its size: 12.9 acres of parkland per 1,000 residents.

Many of the city's parks were part of Pierre L'Enfant's original plan for the city. L'Enfant envisioned and designed a city with broad, tree-lined avenues and plenty of space dedicated to parks in the form of circles at the intersections of major avenues, squares, and smaller triangle-shaped parks where avenues come together. L'Enfant's vision of an open, light, and airy city, embedded in the surrounding natural environment, has largely been maintained over the centuries.

During the 1800s and early 20th century, as the city expanded beyond the original city boundary of Florida Avenue, planners added to L'Enfant's plan by extending many of the avenues, building new circle parks and smaller community parks, and purchasing large tracts of land to be preserved as parkland. Some of the largest tracts of parkland that were created include Rock Creek Park, Glover Park, Anacostia Park, Haines Point, Fort Dupont Park, and Canal National Historical Park.

The parks of Washington, DC, help reduce congestion, noise, and air pollution. Many of the parks are large enough that they are able to preserve habitats for some of the native wildlife and help preserve the water quality and ecosystems of the city's rivers and creeks. The parks create areas of recreation for residents of the city, enabling nature hikes, biking, canoeing, public golf courses, the National Zoo, and numerous athletic facilities. Many of the parks also provide opportunities for education and history, especially the circle of Civil War forts that surround the old city, which were converted into parks in the early 20th century. Much of the beauty and quality of life of the city are owed to its numerous parks.

Capturing the Final District Dataset

The City of Washington, DC's Geospatial Information Systems Department (DC GIS) recently undertook the job of researching and then capturing the dimensional information for these parks in its Vector Property Map (VPM) geodatabase. Until this effort, many of the parks were not well documented, or the documentation of their dimensions was spread across numerous source materials. Now that the project is complete, the District of Columbia government has a centralized inventory of all federal lands inside its city limits.

VPM, which the federal parks were incorporated into, is a vector-based geographic information system that contains property information for the district. Much of the property bearing and dimension information in the VPM has been captured based on extensive research of source documents housed in the District of Columbia's Office of the Surveyor and in the Real Property Tax Administration.

The public lands data was the final, significant, uncaptured dataset within the district.

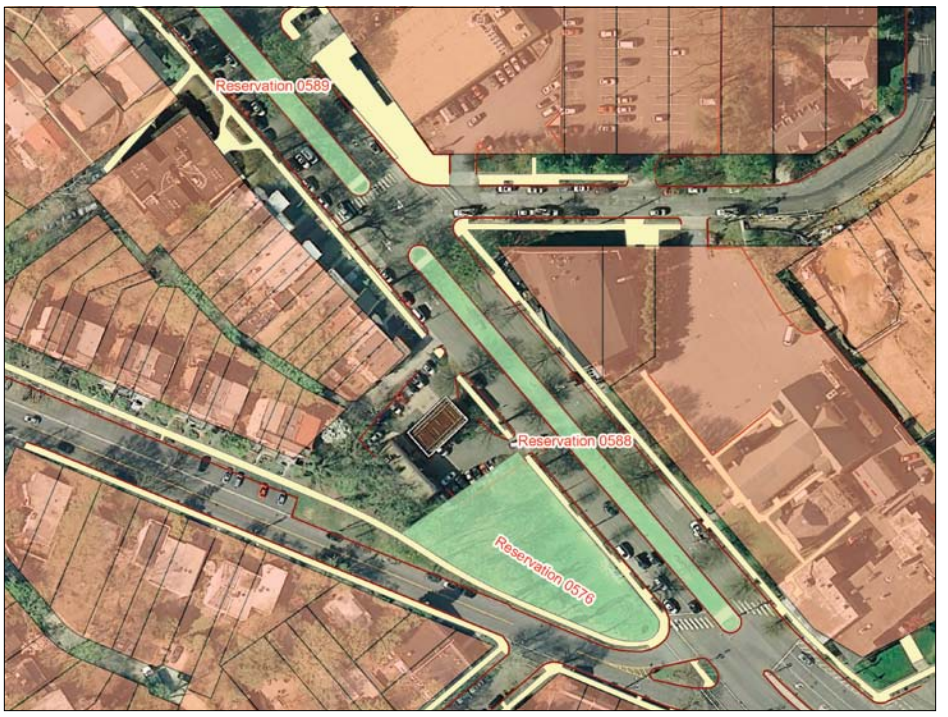
There are roughly 1,150 different reservations, both active and inactive, inside Washington, DC. New Light Technologies, an Esri Partner located in Washington, DC, provided a GIS analyst to work with DC GIS to research and produce this dataset.

The data was captured using ArcGIS software's advanced editing and coordinate geometry (COGO) toolsets, using a disconnected ArcSDE database architecture. Esri products were used for the project because DC GIS has been using Esri software for over a decade and has determined that ArcGIS is the best tool for collecting, managing, and maintaining spatial data.

NPS provided additional resource documents to reference during feature capture. When source material from the Survey Office and NPS did not provide enough information to completely collect a feature, other DC GIS data sources were used, including orthophotos; previously captured record, tax, and parcel lots; and right-of-way polygon, planimetric curbline, street centerline, and waterline layers.

For the creation of most of the reservations, it was necessary to weigh different considerations, looking at all the existing source material comprehensively. Sometimes, there was contradicting information that needed to be sorted through from different sources, or there were areas of a reservation without specific length and bearing information. For some of the larger and more complicated reservations, it was necessary to consider hundreds of documents to get the correct lengths and bearings. There is a narrative field in the reservation line layer that contains the source documents and data referenced to build each reservation boundary. If there are ever any questions regarding a reservation's dimensions in the future, this attribute can be used to research all the relevant references.

Many of the challenges in producing the reservation dataset revolved around making the new reservation line work align with coincident VPM features. In some cases, the line work of an existing lot was the same as the line work for a reservation. This made the collection and placement of the reservation very straightforward. The reservation lot could be created by snapping the new line work to the existing lines and vertices or by copying line work from other existing property lots and city block boundaries. In other cases, lines were created using Esri's COGO toolset. It was possible to use the COGO toolset when there was good documentation



This image shows three reservations whose dimensions were collected with the help of DC GIS planimetric data. The sidewalk data is in yellow, the curb line data is in brown, and the reservations are in green.

that provided lengths and bearings and when the new reservation line work did not conflict with any of the existing coincident lots. The most difficult reservations to capture were those that ran across many city blocks. In these cases, it was often necessary to move and snap existing city blocks and lots to the new line work and, in some cases, rebuild the neighboring lots and city blocks.

Now that this project is complete, there is a single dataset for any person, company, or agency that needs to know the size and location of a reservation in Washington, DC. The detailed dataset that this project produced highlights what public lands are well documented and what portions of the reservations require additional research and surveying. The new dataset improves the daily business processes of the District of Columbia government land management agencies and provides an important data layer for city planners, infrastructure maintenance, land research, business development, community development, public safety operations, the Office of the Surveyor, and the Real Property Tax Administration.

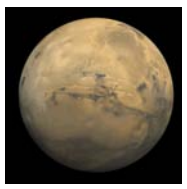
For more information, contact Bill Lescure, GIS coordinator, New Light Technologies (e-mail: bill.lescure@newlighttechnologies.com), or Washington, DC's Office of the Chief Technology Officer, geospatial program (DC GIS) (e-mail: dcgis@dc.gov, website: **dcgis.dc.gov**).

Mapping a Mission to Mars

GIS Aids in Planning the Terrestrial Phase of Mars Science Laboratory Mission

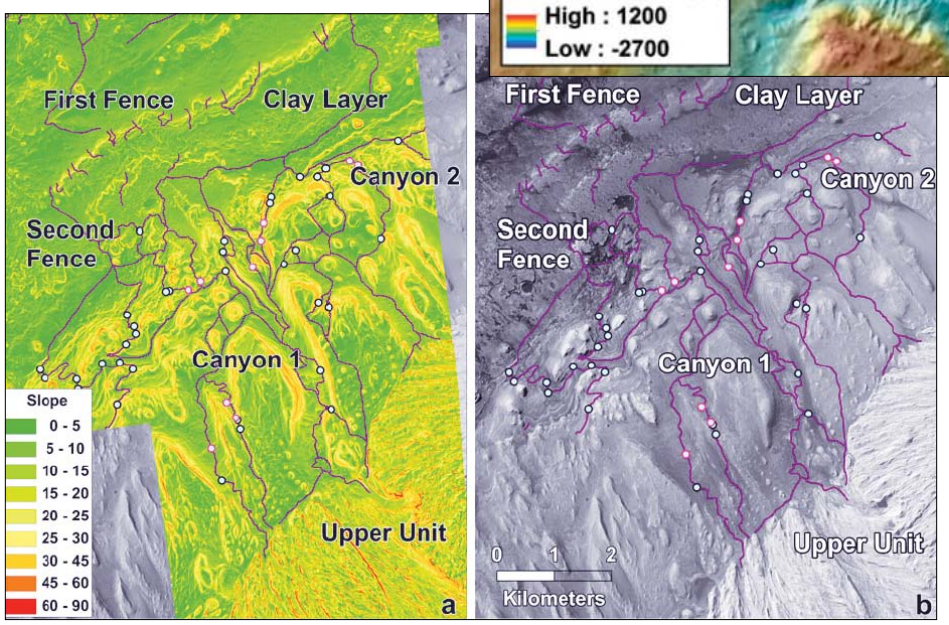
Highlights

- Data from remote-sensing probes orbiting Mars provided basemap imagery to determine ideal landing sites for the rover *Curiosity*.
- Maps give mission planners location intelligence to plan rovers' routes.
- GIS will serve as a strategic planning tool throughout the entire Mars Science Laboratory mission.



Mission planners at the National Aeronautics and Space Administration (NASA) and Jet Propulsion Laboratory (JPL) hugged, hollered, and high-fived when the most sophisticated scientific instrument in the history of interplanetary exploration gently landed on the desert planet this past August. The Mars Science Laboratory (MSL), a compact car-sized rover designed to roam an ancient impact crater searching for clues to Mars' dynamic history, marks the seventh successful landing of a NASA craft on the planet. Outfitted with state-of-the-art optics and sensors, MSL will collect and transmit data back to earth for two years or perhaps even longer.

Navigating through space en route to another planet's surface was only half the battle for MSL engineers. To interact with Mars, *Curiosity*, the six-wheeled vehicle that transports the laboratory to predetermined locations to conduct various experiments, must contend with the Martian terrain itself. Strewn with jagged rocks and boulders, Mars presents innumerable physical hazards that can hobble—or bring to a screeching halt—any mission not meticulously modeled and planned. For this reason, NASA and JPL choose to map their missions using geospatial tools to perform modeling and analysis. MSL mission planners used a combination of ArcGIS and remote-sensing imagery collected in prior Mars missions to achieve the best possible awareness of Mars' diverse terrain and complicated geography.

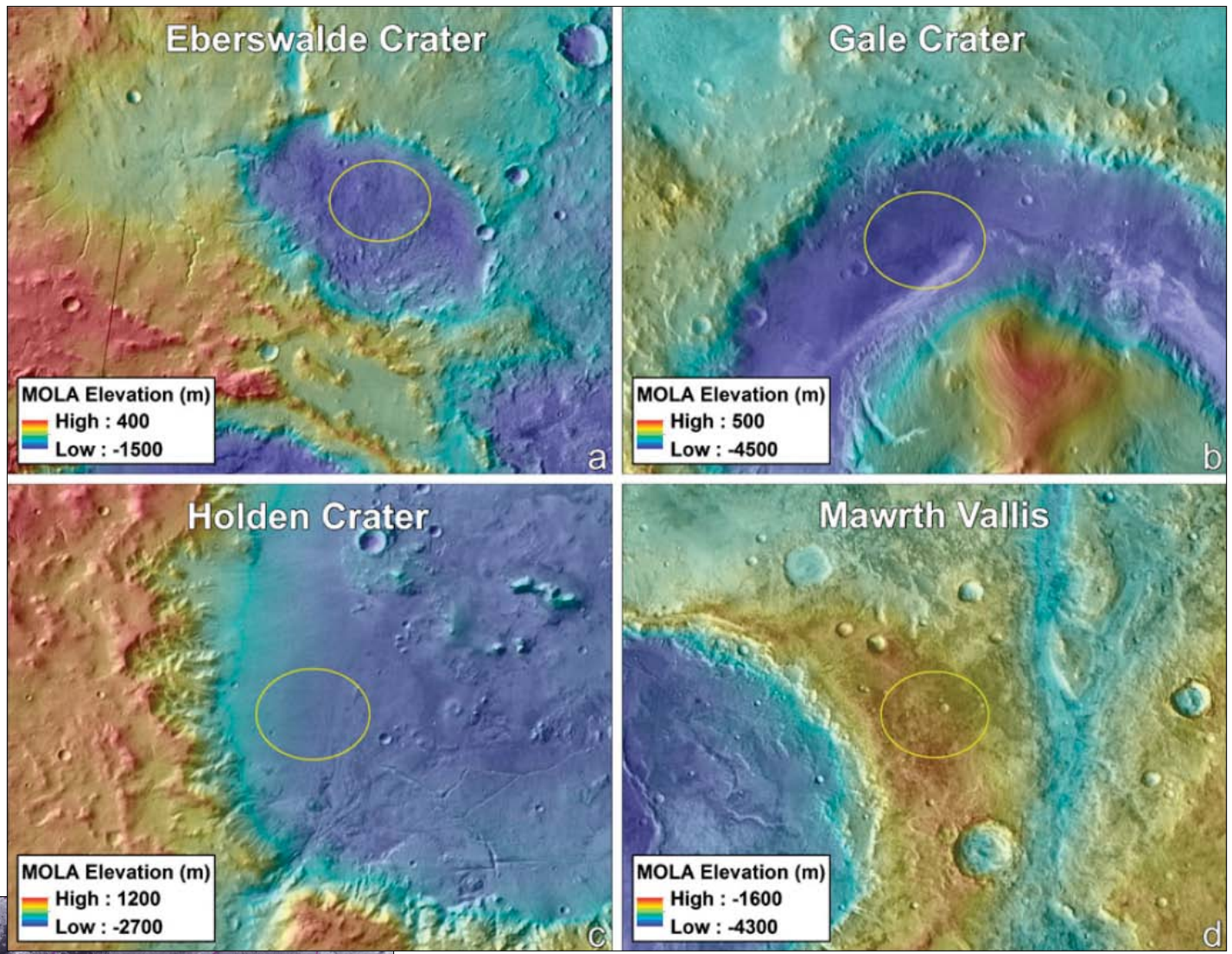


One-meter slope map (a) and corresponding HiRISE image (b) showing traversable paths (in purple) through high science priority clay and sulfate deposits south of the Gale Crater ellipse. Choke points where the traverse path must go through a narrow canyon are shown as dots.

Reconnaissance Imagery

Imagery resources are crucial to construct maps for any terrestrial exploration of a planet, moon, or asteroid. Imagery datasets for MSL mission planning came from three active remote-sensing satellites that have been orbiting Mars for years collecting visible and multispectral photographic data of the Martian surface for their respective assignments. Of those three satellites, the Mars Reconnaissance Orbiter was the last to reach the planet, in 2006, and hence contains the most advanced optics and richest imagery datasets. Called the High Resolution Imaging Science Experiment (HiRISE), it provided the foundational basemap imaging that NASA and JPL needed to construct maps for future rover-based missions.

JPL imported or created hundreds of datasets derived from HiRISE surveys into ArcGIS so that models could be run to process potential landing sites. From that imagery, 30 possible landing locations were considered. Variables important to landing feasibility are geographic in nature, and geospatial analysis helped the mission team narrow down the list of possible landing locations. Geography-related factors included latitude for thermal management of the lab, elevation for sufficient atmosphere to slow the spacecraft, relief for control and fuel management during descent, and slope for rover stability at touchdown. Gale Crater was finally chosen as the study area because it best met the required science and safety requirements of the expedition.



Final four Mars Science Laboratory landing ellipses on THEMIS daytime thermal image mosaic overlaid on MOLA topographic maps: (a) Eberswalde, (b) Gale, (c) Holden, and (d) Mawrth. Ellipses are 25 by 20 km and oriented east–west for the 2011 rover *Opportunity*. The rover *Curiosity* landed in Gale Crater *(map b above)* on August 5, 2012.

Scientific Significance

Channels and canyons on Mars indicate evidence of large amounts of moving liquid water in the planet's distant past. As such, MSL's primary assignment is to provide a more detailed understanding of Mars' chronology, geophysical processes, and life-harboring potential. MSL needed to land in a geologically rich area, but that also required relatively flat terrain nearby so that the rover can land safely and navigate with the least number of obstacles. Small-scale HiRISE imagery with derived rock density and abundance mapped within ArcGIS were essential in determining which sites were safe for landing, as well as traversable, to conduct its scientific experiments.

MSL mission planners created GIS projects for each site candidate to manage and quantify tens of gigabytes of geospatial information, such as digital elevation models (DEMs) and rock abundance maps from HiRISE. Processing the images and DEMs in ArcGIS helped the team establish the best horizontal and vertical geodetic control possible for entry, descent, and landing of MSL. The resultant maps covered roughly 85 percent of the landing ellipses—a percentage more than sufficient to support locational awareness during the entire mission.

Future

GIS will serve as a tactical and strategic planning tool during MSL's traverse operations, as well as serve as a pivotal dataset for creating and evaluating new science throughout the mission.

For more information, contact Fred J. Calef III, PhD, scientific applications software engineer II, Jet Propulsion Laboratory (e-mail: fcalef@jpl.nasa.gov, tel.: 818-393-1548).

Roving the Red Planet

Curiosity

The National Aeronautics and Space Administration's Mars rovers have been a huge success story. Two of the four rovers are actively at work, including Mars Science Laboratory—*Curiosity*. See the story map at **storymaps.esri.com/stories/2012/marsrovers**.

Surveying Mercury

Transforming Data from the MESSENGER Mission to Mercury into Actionable Maps

Highlights

- To transform high-resolution, low-angle images into a comprehensive cartographic record, researchers use ArcGIS.
- Researchers must know what the maps tell them before they can proceed any further scientifically.
- GIS is the cornerstone to managing MESSENGER's image data.

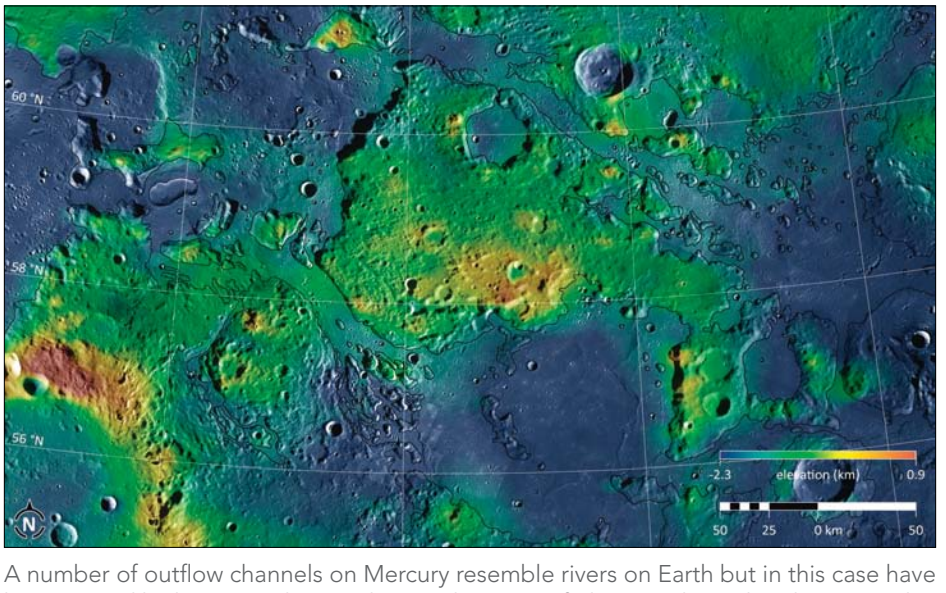
The solar system's innermost planet, Mercury holds important clues about terrestrial planet formation. However, Mercury's proximity to the sun limits Earth-based observation (for example, magnified sunlight would fry a telescope's delicate optics). In 2004, the National Aeronautics and Space Administration (NASA) launched a surveillance orbiter to Mercury called MESSENGER (Mercury Surface, Space Environment, Geochemistry, and Ranging) to gain a clearer understanding of the planet's makeup and history. The first craft to enter orbit about Mercury, MESSENGER began beaming back high-resolution, low-angle images of the planet in 2011. To transform that data into a comprehensive cartographic record, researchers at the Department of Terrestrial Magnetism at the Carnegie Institution of Washington process the data in ArcGIS.

Of all the inner planets—Mercury, Venus, Earth, and Mars—scientists know the least about Mercury. Much of what we do know came from flybys of the planet in the 1970s by NASA's Mariner 10 probe, which discovered that Mercury generates a magnetic field (making it the only terrestrial planet besides Earth known to have one) and hosts some of the largest-known impact craters in the solar system. Those and other intriguing facts inspired the design of the MESSENGER spacecraft to expand our knowledge of Mercury and, possibly, the evolution of the inner solar system itself.

Clean, high-resolution basemaps of a planet's surface provide a foundation for scientists to begin their investigations. Without a large-scale depiction of an area and its features, context cannot be determined, and comparisons with other areas—and with other worlds—are difficult to make.

"Only after making maps of Mercury can we start thinking about what geological processes took place there and how we might study them through laboratory work, numerical modeling, and analysis of analog terrain," says Paul Byrne, a geologist and GIS specialist with the Department of Terrestrial Magnetism. "We need to know what the maps tell us before we can proceed any further scientifically."

Nearly all of Mercury's surface will be imaged in stereo to characterize the planet's long-wavelength global topography and to gain insight into the nature of its enigmatic landforms. To accomplish those goals, MESSENGER includes a wide-angle, low-resolution camera and a high-resolution, narrow-angle camera, which together continually acquire different sets of image data and transmit the information back to Earth. After the data is processed by MESSENGER personnel at Johns Hopkins University Applied Physics Laboratory in Laurel, Maryland, where the mission is managed, Byrne selects portions of the global image basemap for study within ArcGIS.



A number of outflow channels on Mercury resemble rivers on Earth but in this case have been carved by lava, seen here with a combination of photogeological and topographic data from MESSENGER.

"GIS is the cornerstone to managing all of MESSENGER's image data," says Byrne. "All remote-sensing missions require geospatial tools to transform information, such as photogeological and topographic data, into actual maps we can use."

The MESSENGER mission to Mercury is now in its second year of remotely sensing the planet from orbit. MESSENGER team members will continue to transform data from the mission into maps within ArcGIS that will be made accessible to other planetary scientists through NASA's Planetary Data System. ArcGIS tools, such as 3D Analyst and Spatial Analyst, together with the ArcMap and ArcGlobe programs, allow Byrne and his colleagues to visualize Mercury in new and exciting ways.

For more information, contact Paul Byrne, MESSENGER, Department of Terrestrial Magnetism, postdoctoral fellow, Carnegie Institution of Washington (e-mail: pbyrne@dtm.ciw.edu).

Citizen Scientists Map Venus Transit

Esri Builds Astronomy Observations Map Application

Highlights

- Astronomers Without Borders and Esri built an application that instantaneously displayed participants' observations.
- The transit data was collected on a central server and displayed just seconds later.
- Powered by GIS, the 2012 Transit of Venus project may well be one of the largest crowdsourced mapping projects to date.

NGO Non-Governmental Organization

During a Venus transit, the planet appears as a small dot moving across the sun, an event lasting approximately six hours. Transits of Venus occur in pairs eight years apart, separated by more than a century. Since the last Venus transit was seen in 1882, no one living today had experienced one until 2004, the first of a pair culminating in 2012.

Working with Astronomers Without Borders, Esri built a web map application that instantaneously displayed participants' transit of Venus observations as part of a historic project. Under the aegis of Astronomers Without Borders, Dutch high school physics teacher Steven van Roode developed an iPhone application to allow people to contribute their observations of the transit to a central database. Esri designed the web map application ToV2012, which worked in conjunction with the iPhone application. On June 5 and 6, 2012, 25,000 amateur astronomers from around the world used the free application on their smartphones to record important timings during the transit.

The transit data was collected on a central server and displayed just seconds later via the ToV2012 web map application running on ArcGIS for Server. The dynamic map was published on the Esri and Astronomers Without Borders websites. The Esri application included an animation showing how Venus would appear as it traveled across the sun, as well as which regions of the earth would be able to view it and at what times. As the earth rotated, these citizen scientists' observations lit up a separate map in near real time.

For 500 years, the transit of Venus has been a marker of technological advancement. In the 17th century, two people witnessed the event by using the newly invented telescope. In the 18th century, astronomers' measurements of the transit of Venus were used to calculate the distance between the earth and the sun.

Edmond Halley (think Halley's Comet) proposed the idea of using the transit of Venus as a means to measure the size of the solar system. Observers at widely separated locations could record the exact time Venus moved from edge to edge across the sun's disk. The observers, seeing the sun at different angles, would record two distinct paths of Venus due to parallax. Mathematicians could use these observation times to geometrically calculate the distance from the earth to the sun.

Left: This image of Venus eclipsing the sun was taken with an Apple iPhone 4. **Above:** Crowdsourced observations are published on the ToV2012 mapping application.

During the 1761 and 1769 transit of Venus, astronomers and explorers recorded the times and location of their sightings. Fifty years later, a German astronomer determined the solar parallax to be 8.57 arc seconds, giving a distance from earth to the sun of 95,000,000 miles (152,887,680 kilometers).

The 1874 and 1882 transits were recorded using the newly invented camera. Ten years later, the director of the United States Naval Observatory determined the solar parallax and calculated the earth-to-sun distance to be 92,797,000 +/- 59,700 miles (149,342,295 +/- 96,007 kilometers).

By the time the transit of Venus came around in 2004, use of broadcast media and the Internet was global. Telescopes on earth and in space were trained on Venus, and the transit was televised around the world. In the eight years between then and the 2012 transit, technology has advanced to include GIS, smartphone and tablet applications, social media, and light clients built on a superfast Internet infrastructure.

For more information about Astronomers Without Borders, the 2012 Transit of Venus project, and other galactic marvels, visit **www.AstronomersWithoutBorders.org**.

ArcGIS Online What's New?

This regular column contains information about the latest updates to ArcGIS Online, including basemaps and content contributed by the global user community through the Community Maps Program, as well as new features and capabilities in ArcGIS Online.

ArcGIS Online Basemap Updates

Esri has entered into an agreement with DigitalGlobe for its Global Basemap layer that will add 100 million square kilometers of high-quality imagery at multiple, substantially higher resolutions to the World Imagery Map. The imagery will be added in batches over time, in addition to the GeoEye IKONOS imagery, some of which has already been released as part of the World Imagery Map. Recent updates include expanded coverage for parts of Europe, Russia, China, Canada, Mexico, Pakistan, Central America, Indonesia, and Malaysia. We will continue to update the World Imagery Map over the next few months as we process and publish the GeoEye IKONOS imagery.

As the Community Maps Program continues to grow, so do the contributions from the user community around the world. The World Topographic Map receives the most contributions of authoritative content. Updates since the last column was written include content for several areas in Canada at 1:9,000 to 1:1,000, including Banff and Camrose in Alberta; the City of Brampton, London, Niagara Falls, and University of Waterloo in Ontario; the City of Quebec, Quebec; the Rural Municipality of Headingley, Manitoba; and Kamloops, British Columbia, as well as the Hamlet of Enterprise, Northwest Territories, at 1:18,000. Other international content includes the Canton of Geneva, Switzerland, at 1:9,000 to 1:1,000; the country of the Netherlands at 1:72,000 to 1:1,000; the states of Rheinland-Pfalz, Nordrhein-Westfalen, and Schleswig-Holstein in Germany at 1:144,000 to 1:2,000, and the city of Hamburg, Germany, at 1:72,000 to 1:1,000; Japan at 1:577,000 to 1:1,000; Nigeria at 1:577,000 to 1:18,000; the cities of Maracaibo and San Francisco, Venezuela, at 1:72,000 to 1:1,000; major cities in Iceland at 1:9,000 to 1:1,000; and Warsaw University of Life Sciences, Warsaw and Rogow Campuses, in Poland at 1:9,000 to 1:1,000.

Several areas in the United States also include new and updated content at 1:9,000 to 1:1,000, such as Greenville County, South Carolina; Indian River County and Tampa, Florida; Teller County, Greenwood Village, and Denver, Colorado; Appleton and Polk County, Wisconsin; Old Dominion University, Virginia; Bakersfield, Riverside County, and Sequoia and Kings Canyon National Parks, California; Chester County, Pennsylvania; Des Moines, Iowa; Houston, Texas; Mecklenburg County, North Carolina; Nashua, New Hampshire; Sussex County, New Jersey; and more.

The Ocean Basemap, the latest addition to the Community Maps Program, has received contributions from the University of New Hampshire Center for Coast and Ocean Mapping/Joint Hydrographic Center at scales of 1:2,300,000 to 1:577,000 for several areas, including the Mariana Trench, Gulf of Alaska, and Sigsbee Escarpment; and from the Davey Jones' Locker Seafloor Mapping/Marine GIS Lab at Oregon State University for a number of areas in both the Pacific and Atlantic Oceans, including more detailed bathymetry over American Samoa at 1:2,300,000–1:577,000. Other updates include bathymetric data from the Canadian Hydrographic Service for the east and west coasts of Canada. A large coastal area from Dixon Entrance north of Haida Gwaii (Queen Charlotte Islands, Queen Charlotte Sound) to the Strait of Juan de Fuca now includes bathymetry at a resolution of 1:500 meters. On the Atlantic Coast, in the Gulf of St. Lawrence, the St. Lawrence River, around the islands of Nova Scotia and Newfoundland (Notre Dame Bay), and further north along the Labrador coastline (Labrador Trough), an improved resolution of up to 1:100 meters is now available.

World Imagery Map now includes expanded GeoEye IKONOS imagery for Shanghai, China.

The Light Gray Canvas Map was updated to make it much more useful for thematic mapping. It now contains additional worldwide and detailed nationwide coverage for nearly 50 additional countries, including boundaries, city labels and outlines, and major roads worldwide from 1:591,000,000 to 1:72,000. More detailed nationwide coverage is now available in Europe, southern Africa, South America, and Australia, to be fully consistent with the World Street Map and World Topographic Map down to 1:9,000. The Light Gray Canvas Map was developed by Esri using NAVTEQ data for North America, DeLorme basemap layers, and Esri basemap data.

To stay up-to-date with the latest content updates and basemap releases, go to **resources.arcgis.com** and click Blogs, and then click ArcGIS Online under Technical Communities on the right side.

New ArcGIS Online Features and Enhancements

At the International User Conference in San Diego this past July, Esri announced Esri Maps

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Esri Maps for Office Is Now Available

As part of ArcGIS Online, Esri Maps for Office enables the use of familiar Microsoft Office tools to quickly and easily map and share data.

Users can create maps directly in Excel and add them to PowerPoint presentations and other documents. They can publish and share maps on ArcGIS Online that others in an organization can then use to visualize and interact with their data. Maps published on ArcGIS Online can also be viewed or embedded in web pages or desktop and mobile applications.

All that's needed to get started using Esri Maps for Office is an ArcGIS Online paid or trial subscription, along with Microsoft Office 2010 or later.

Make Maps Directly in Excel

Users can create interactive maps of their Excel data—not only maps of locations (e.g., customer addresses, sites by map coordinates, facilities, businesses, opportunities, distribution points) but also maps of geographic data, such as color-coded maps of sales by ZIP code or enrollment by state.

Through tight integration of Esri Maps for Office with ArcGIS Online, users can access a variety of background maps, including street, satellite, and topographic maps. They can also reuse and incorporate (mash up) any map to which their organization provides access, as well as tens of thousands of maps published by Esri's worldwide user community.

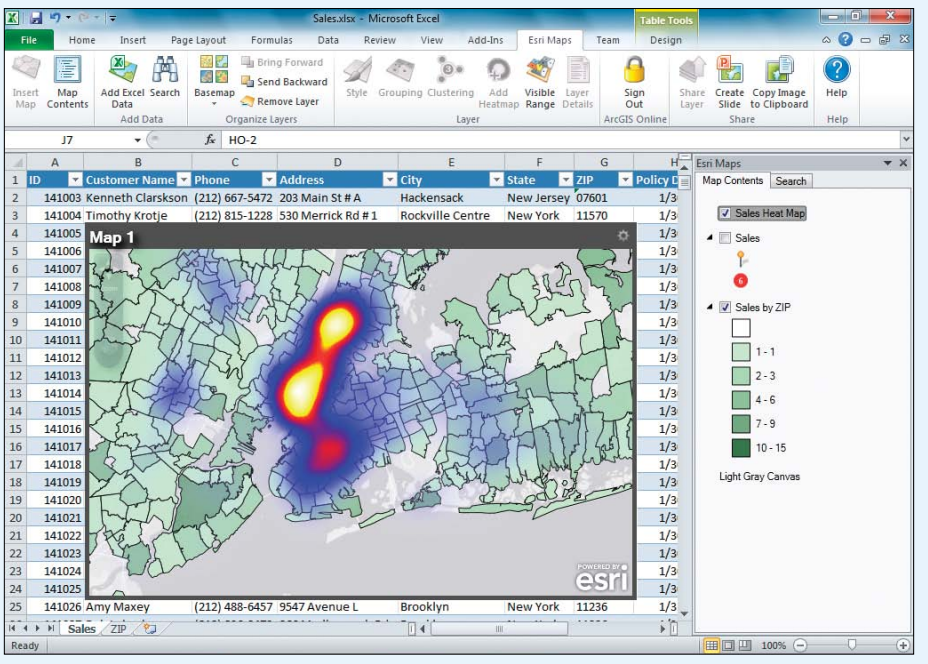
Impact Your Audience

Maps are powerful communication tools that help users get their points across quickly and efficiently. Maps can also help them look at their data in different ways to gain additional insight.

Once a map has been made, the results can be immediately shared with others by adding them to PowerPoint presentations or by one-click publishing to ArcGIS Online. Both interactive and static maps can be shared. Users have full control over the map symbols and map styling so that they can tell their stories the way they want.

Part of ArcGIS Online

With the ArcGIS Online collaboration capabilities and valuable content, Esri Maps for Office enables the use of familiar Microsoft Office tools to quickly and easily map and share data inside and outside an organization.



Make interactive maps inside Microsoft Excel and PowerPoint with Esri Maps for Office.

Esri Maps for Office is made available as a component of ArcGIS Online. It's delivered as an add-in to Microsoft Office, and current ArcGIS Online subscribers can get it as part of their subscription.

For more information, visit **esri.com/software/esri-maps-for-office**.

for Office, a new feature of ArcGIS Online. With Esri Maps for Office, ArcGIS Online subscribers can create interactive point maps, clustered point maps, and heat maps of data directly inside Excel and control how the maps are styled, so they can emphasize the information that's important. Once done, users can share maps in ArcGIS Online with others in the organization or copy them into PowerPoint. Using Esri Maps for Office requires an ArcGIS Online trial subscription or a paid subscription. *[Read more in the sidebar article on page 22.]*

We've added a Health Dashboard so users can check the service status and availability of ArcGIS Online. This includes the website (**arcgis.com**), basemap services, REST API, hosted feature and tile services, and more. To view the dashboard, go to **status.arcgis.com**. Users can also subscribe to individual RSS feeds by service type to keep up-to-date. To help users monitor service credit usage within an organizational subscription, we added detailed reports about storage, computation, and bandwidth usage. Each report displays the number of units and credits used over a selected amount of time, for example, the last 24 hours or the current month, in a table, as well as charts. General information about the organizational ArcGIS Online subscription is also provided, including how many members are in the subscription and how many service credits remain. ArcGIS Online subscription administrators can view the status of their subscription by going to the My Organization link at the top of their ArcGIS Online site and then clicking the View Status link underneath the Subscription Status section of the page.

To better explain service credit usage in general, we've created a web page that provides an overview and examples of what does and does not use service credits in ArcGIS Online. Go to **esri.com/agolcredits** to view this information.

Other new features include the addition of configurable story map and mobile templates; the ability to choose whether to include a link that opens a larger view of a map; and giving administrators of the ArcGIS Online subscription the option to include social media links in their organizational ArcGIS Online site.

Other Improvements

We have created a number of short tutorial videos to guide users through the major features and functions of ArcGIS Online. These videos now include captions for all 16 languages supported in ArcGIS Online. These videos are accessible from ArcGIS Online Help by clicking Getting started and then clicking Videos in the table of contents. To see a complete list of all supported languages, click Setting language and region under Getting started.

Users whose organization doesn't have an ArcGIS Online subscription yet can sign up for a free 30-day trial, invite up to five named users to participate, and get 200 service credits and Esri Maps for Office as part of the trial. When the trial is over, they can purchase a subscription and continue to use all the features and services in the same ArcGIS Online subscription account. To sign up for the trial, go to **esri.com/agoleval**.

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Free, New Version Available

ArcGIS for AutoCAD: Maximize CAD and GIS Across the Enterprise

For engineers and planners who use AutoCAD to construct and maintain drawings of infrastructure and utilities, Esri's latest release of ArcGIS for AutoCAD simplifies the communication of information between the CAD and GIS platforms. ArcGIS for AutoCAD is a free plug-in that allows users to access, create, edit, and share GIS data inside AutoCAD. Through ArcGIS for AutoCAD, GIS and CAD users can share information throughout an organization without costly add-on software, conversion, or complex workflows. Most notably, ArcGIS for AutoCAD users with read/write access to ArcGIS for Server feature services can now edit geodatabases through AutoCAD.

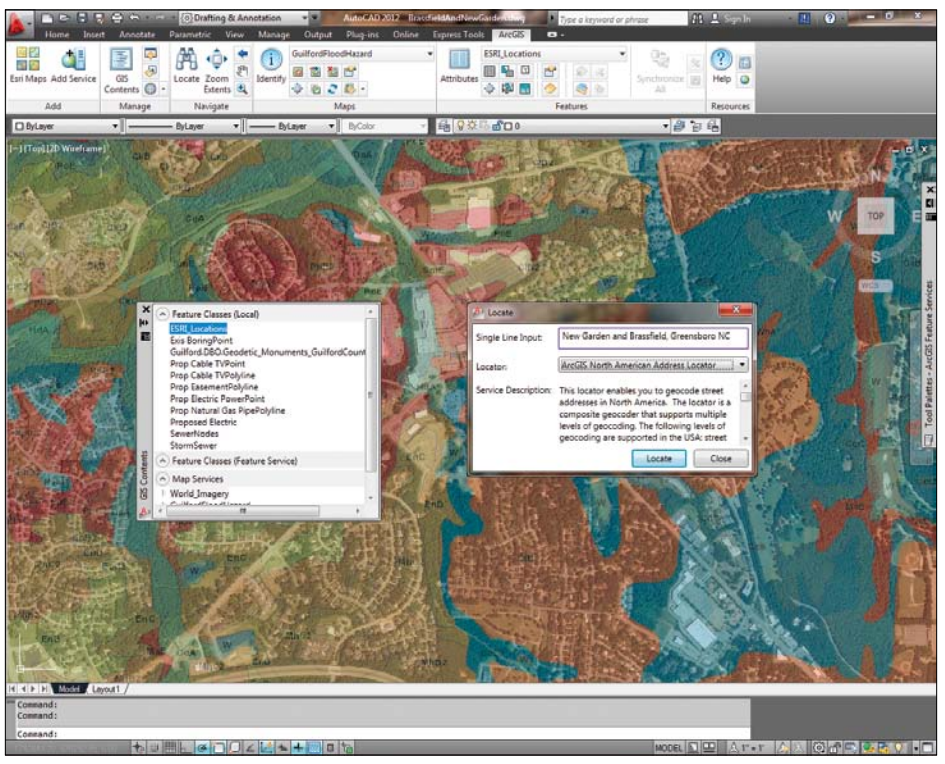
ArcGIS for AutoCAD is the interface into the ArcGIS system for AutoCAD users. Through this interface, they can access all the data content, sharing, and data management available in ArcGIS. AutoCAD files created with ArcGIS for AutoCAD include GIS data stored completely within the AutoCAD file and are directly usable as ArcGIS datasets. The advantages of using this free plug-in are numerous: workflows are faster, duplicate efforts are eliminated, and everyone across the enterprise becomes more empowered in their daily work with this added access.

ArcGIS for AutoCAD users can do the following:

- Edit ArcGIS geodatabases through a feature service
- Add Esri map and imagery services, such as from ArcGIS Online
- Add maps from enterprise or cloud servers
- Navigate within drawings by using a street address
- Create ArcGIS feature classes in AutoCAD
- Extract GIS data from feature services

AutoCAD 2010/2011/2012 (32 bit and 64 bit) systems are supported.

Free download available—To learn more about ArcGIS for AutoCAD and to download it, visit **esri.com/autocadapp**.



Use ArcGIS for AutoCAD to access a geolocation service and locate place-names in your drawing.

New Features and Enhancements

Leverage ArcGIS Online with ArcGIS Explorer Desktop

The new ArcGIS Explorer Desktop release includes new features and enhancements to make it a more powerful tool in your GIS enterprise. ArcGIS Explorer Desktop is a free GIS viewer that gives you an easy way to explore, visualize, and share GIS information.

Among the most important aspects of ArcGIS Explorer Desktop is the ability to easily upload GIS content directly to your ArcGIS Online account. This gives anyone with Internet access the ability to see your work. ArcGIS Explorer Desktop is further integrated with ArcGIS Online and Portal for ArcGIS via support for sharing, roles, custom basemap galleries, and organization-specific search. You can search shared content on ArcGIS Online or private content hosted in your on-premises cloud.

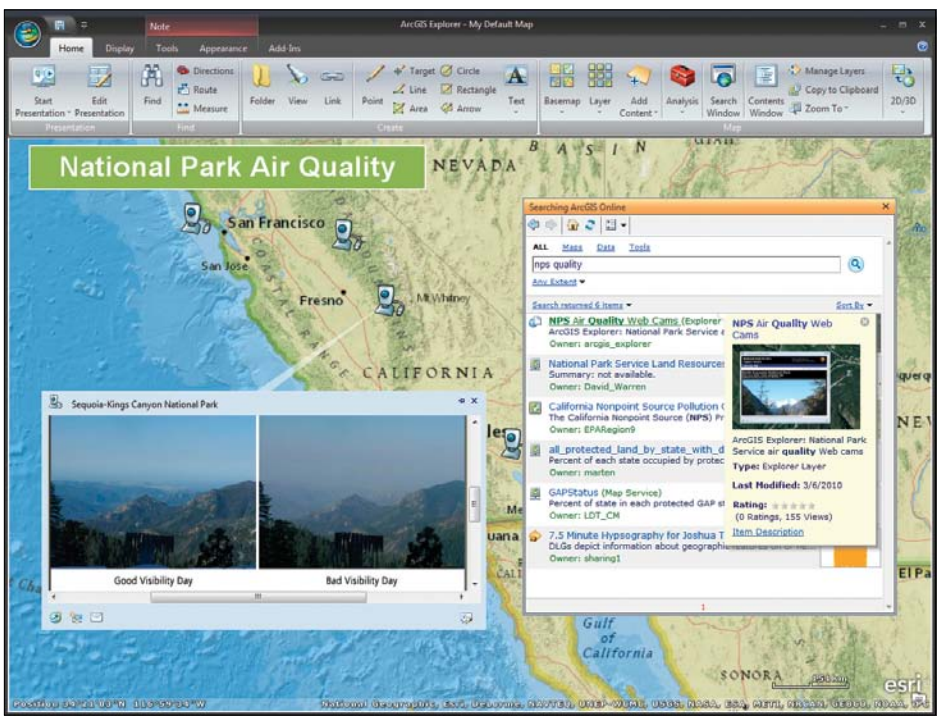
Another new feature is the ability to display attribute tables for feature layers. With a single click, you can view a table showing all the records for a selected feature layer. Selected records can be written to a CSV file or added to the map.

Built-in presentation capabilities have always been a popular aspect of ArcGIS Explorer Desktop, and with this release, users have even more tools for creating engaging, interactive presentations. These tools include slide animations, timed transitions, audio synchronization, and presentation markup.

No installation is needed to work with ArcGIS Explorer Desktop. Starting with this release, ArcGIS Explorer Desktop can be run from an external USB-connected drive on any computer that meets the ArcGIS Explorer Desktop system requirements.

Additional aspects of this release include the ability to control the size and position of pop-up windows, full support for KML tours, and the ability to use custom locators.

Download ArcGIS Explorer Desktop from **esri.com/explorer**.



Easily search for ArcGIS Online content and add it to your ArcGIS Explorer Desktop projects.

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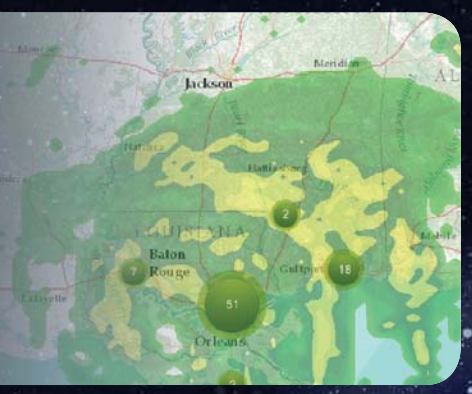
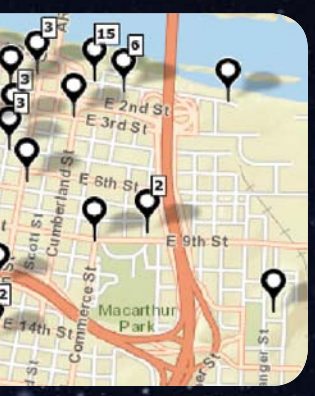


Esri and IBM Are Helping Our Customers Apply the Po

For more than 25 years, Esri and IBM have collaborated to bring the value of mapping, location analytics, to the world's leading government and private organizations. As our cities grow and the pressures on our working together to lead, innovate, and deliver geography-based platforms and solutions to improve the environments, and resources and ensure better outcomes for all its inhabitants.

Smarter Planet



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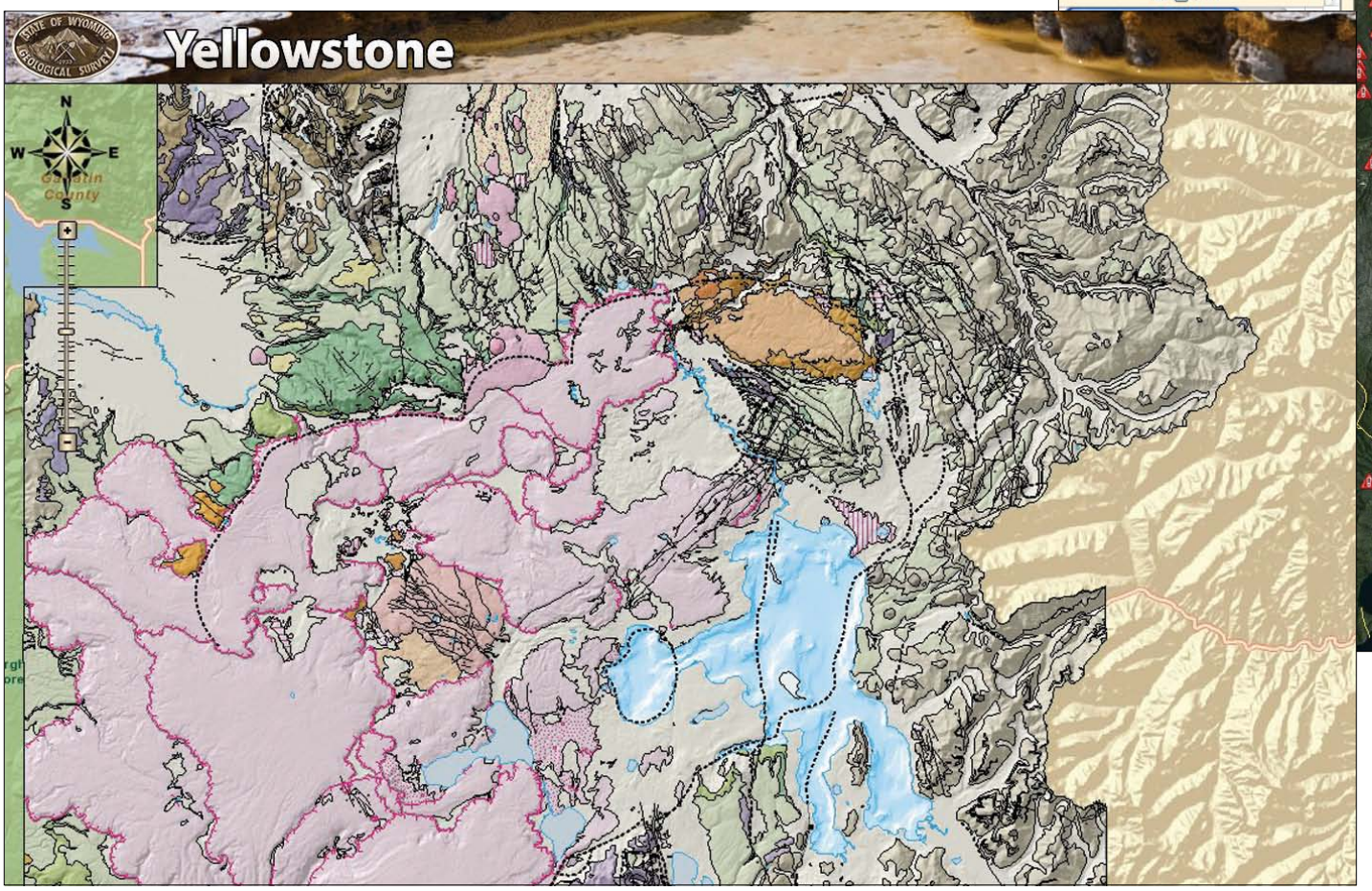
New Yellowstone Website Provides Interactive Maps on Volcanic Activity

By Chamois Andersen, Communications and Public Outreach, Wyoming State Geological Survey

Highlights

- The central clearinghouse of information was built with ArcGIS for Server.
- Web mapping includes a mashup of live data feeds, high-resolution digital elevation models, and an array of geologic datasets.
- Via ArcGIS, website users expand their perspective of Yellowstone through layers of information.



The map illustrates the geology, earthquakes, and hydrothermal areas that make up Yellowstone National Park. The website allows users to view layers ranging from past geologic events to satellite imagery, lake bathymetry, and volcano monitoring equipment in the park.

The Yellowstone Plateau in northwestern Wyoming has a long geologic history—earthquakes; expanding and retreating glaciers; rising mountains; powerful geothermal explosions; and cataclysmic volcanic eruptions, the most recent of which was the Yellowstone Supervolcano, which erupted 640,000 years ago. Today, the region is a geologic marvel, with one of the largest remaining ecosystems in North America and the world's largest concentration of geysers. More than six million visitors each year travel to Yellowstone to experience its geologic forces. But how can the Wyoming State Geological Survey (WSGS), charged with providing knowledge on geology and energy resources in the state, and with such an incredible testing ground like Yellowstone, better reach a broad audience interested in learning about the park's geologic past? How can the public better appreciate this geologic wonderland? And what innovative web-based tools can be used to showcase the park and provide knowledge on its geologic history, a story so important to the creation of the Greater Yellowstone Ecosystem?

WSGS created the Yellowstone Geologic GIS Database at **www.wsgs.uwyo.edu/Yellowstone** as an interactive website, providing researchers and students alike with a look into Yellowstone's geologic past and present.

GIS experts and geologists with WSGS and the United States Geological Survey (USGS) collaborated to create a central portal, or clearinghouse, of information on the volcanic eruptions and earthquakes that have created the Yellowstone landscape that continues to evolve today.

This project involved first collecting and compiling data related to Yellowstone's geologic past, including GIS datasets; unpublished bedrock and surficial datasets and maps; and seismic catalogs, field data, hydrologic data, and relevant earth science or cultural datasets. These were provided by a variety of state and federal entities and converted into standardized file types and common databases, including shapefiles and KML files, as well as for a geodatabase. The final step for implementation was to provide the public with access to the data via the WSGS website, which includes multiple downloadable formats for a wide array of users. The GIS applications were created using the ArcGIS for Server Web Application Developer Framework (ADF). This application allows USGS and WSGS staff to update maps, graphs, and charts with near real-time data. Scientists can use the data to create figures and plots of real-time information on dynamic hazardous conditions.

"The past and present geologic activity that continues to shape and form Yellowstone is of great importance and interest to scientists, policy makers, and the public," says Tom Drean, state geologist and director of WSGS. "By creating and updating this interactive website, we are providing past knowledge and current information that can be easily accessed by anyone with an interest in this geologic wonderland," he continues.

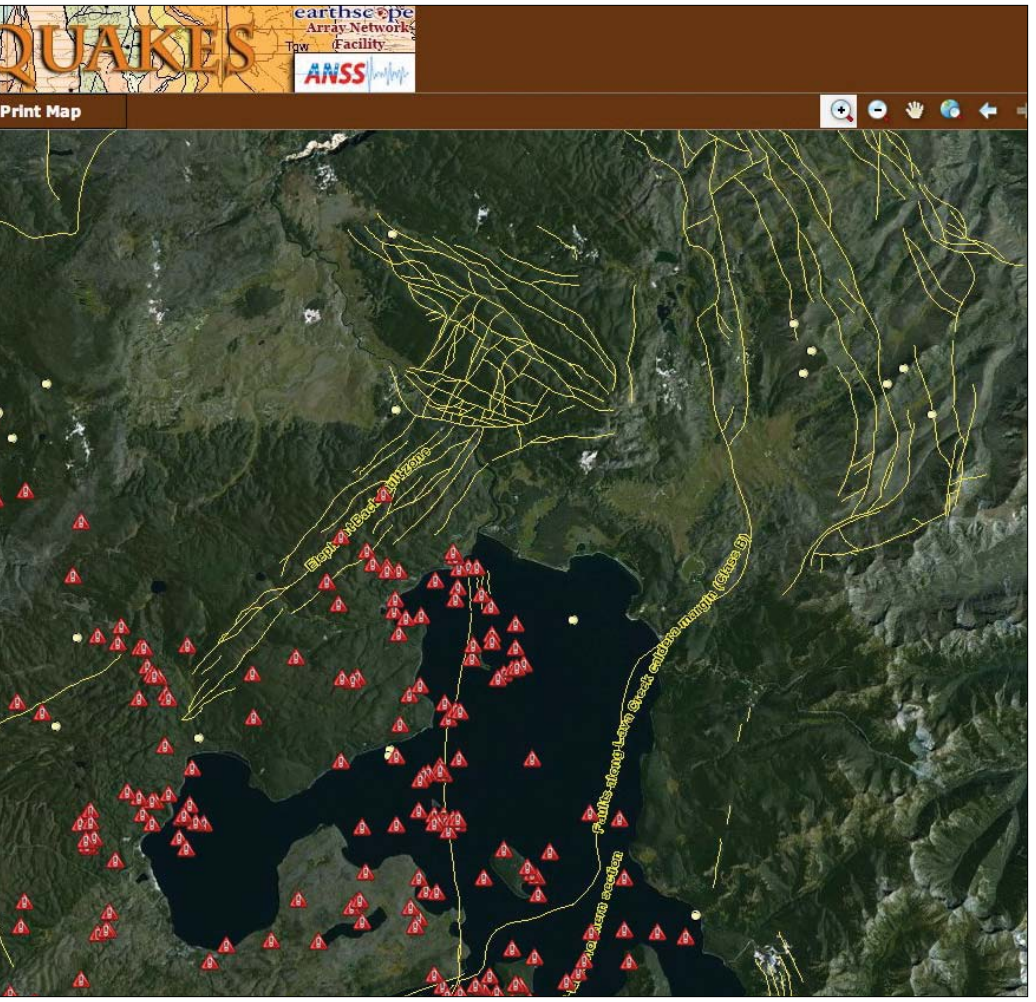
Interactive maps illustrate the geology, earthquakes, and hydrothermal areas that make up Yellowstone National Park. The site includes downloadable GIS datasets that allow students and researchers to view layers ranging from past geologic events to satellite imagery, lake bathymetry, and volcano monitoring equipment in the park. The data can also be viewed via Google Earth with 3D visualizations of the area.

WSGS created the website as an educational information portal, representing a major collaboration between WSGS and USGS staff. "This product is a good example of what can be accomplished when agencies cooperate and work toward a common goal," Drean says.

The WSGS Yellowstone Geologic GIS Database website includes the following:

- More than 20 datasets available to download (individually or combined)
  - High-resolution lidar and digital elevation models
  - Earthquake data (historical and current)
  - Geology (bedrock, surface, geothermal, etc.)
  - Hydrography (bathymetry of Yellowstone Lake)
  - Other information (trails, place-names, boundaries)

Norris Geyser Basin is the hottest geyser basin in Yellowstone.



The Wyoming Earthquake Database allows users to search earthquakes in the park by magnitude and date.

- Interactive mapping application
  - Live webcams
  - USGS live earthquake feed
  - Ability to search earthquakes in the park by magnitude and date
  - Print map feature

- Media gallery
  - High-resolution photos of the park
  - USGS videos of the Yellowstone Caldera

The website's main feature is a searchable map of Yellowstone that was created by combining data from a variety of state and federal sources into a single GIS database. The interactive map includes an overlay of colors representing different types and ages of rock. A user can then add various layers to the map, such as topography and imagery (with zoom capability), and even search for earthquakes in the area by typing in a minimum and/or maximum magnitude and the years of interest.

"The flexibility and breadth of information contained on the website allows people to quickly review information that is of greatest interest and use to them," Drean adds.

The present Yellowstone Plateau developed through volcanic cycles spanning 2 million years that included some of the world's largest known eruptions. The Yellowstone region includes three calderas: the first cycle caldera formed 2.1 million years ago during the eruption of the Huckleberry Ridge Tuff; the Henry's Fork Caldera formed 1.3 million years ago near the present location of the town of Island Park; and the Yellowstone Caldera formed 640,000 years ago during the eruption of the Lava Creek Tuff—an event that spread ash over much of the North American continent. Since that time, there have been approximately 80 additional but smaller eruptions, such as lava flows. The youngest of these range from 70,000 to 160,000 years old.

"The volcanic events that formed Yellowstone were not the products of many millions of years of geologic change ending many millions of years ago. We are seeing a time scale compressed into only the last 2.1 million years," Drean says. For the Greater Yellowstone Ecosystem, geologists and volcanologists study in detail the latest periods of geologic time, the Pliocene and the Quaternary, covering the last 5 million years out of 4,500 million.

Yellowstone's geologic story also includes earthquakes, such as the Hebgen Lake earthquake of 1959 near West Yellowstone (magnitude 7.5). "This was a major earthquake," says Jacob Lowenstern, scientist in charge of the USGS Yellowstone Volcano Observatory. "It fractured geothermal reservoirs in Yellowstone, creating new geysers and destroying others. Flow rates and temperatures of hundreds of hot springs changed overnight," he said.

Data collection, the use of Esri software and other applications, and the mapping efforts of WSGS are intended to further research on Yellowstone's geologic past and future. "With this web-based tool, we have assembled data from a host of research entities into a single searchable format," Drean says. "This website will be continually updated, providing us with the opportunity to interpret the past and plan for the future of Yellowstone. And if the past gives us a glimpse for what is to come, we know the Yellowstone landscape will continue to change."

About the Author

Chamois Andersen writes and publishes reports for a broad audience concerned about the environment and natural resources. In her current role, she serves as head of Communications and Public Outreach for WSGS. Previously, she worked as a public information officer for the University of Wyoming's Environment and Natural Resources Program, as well as for the California Department of Fish and Game and the Colorado Division of Wildlife.

For more information, contact David Lucke, GIS/IT manager, Wyoming State Geological Survey (e-mail: david.lucke@wyo.gov; tel.: 307-766-2286, ext. 232).

Can GIS Help Fight the Spread of Malaria?

Zambia Tries Out New Tactic on an Old Opponent

By Emmanuel Chanda, Victor Munyongwe Mukonka, David Mthembu, Mulakwa Kamuliwo, Sarel Coetzer, and Cecilia Jill Shinondo

Highlights

- The DSS harnesses transmission-determining parameters to better evaluate viable options for malaria vector control.
- The ArcGIS software-based system incorporates large datasets, maps, satellite images, and aerial photos to aid in prompt surveillance and policy formulation.
- The system helps identify areas that require specific intervention measures, such as indoor spraying and insecticide-treated nets.

In Zambia, which is situated in southern Africa, malaria remains a major cause of illness and mortality. Its transmission is driven by a complex interaction between the vector (i.e., the mosquito that transmits the disease), host, parasite, and the environment and is governed by different ecological and social determinants. The survival and adaptation of malaria vectors are affected by climate variability, that is, variability in rainfall, temperature, and relative humidity. As a result, even minute spatial variations and temporal inconsistencies in the mosquito population can significantly increase the risk of malaria.

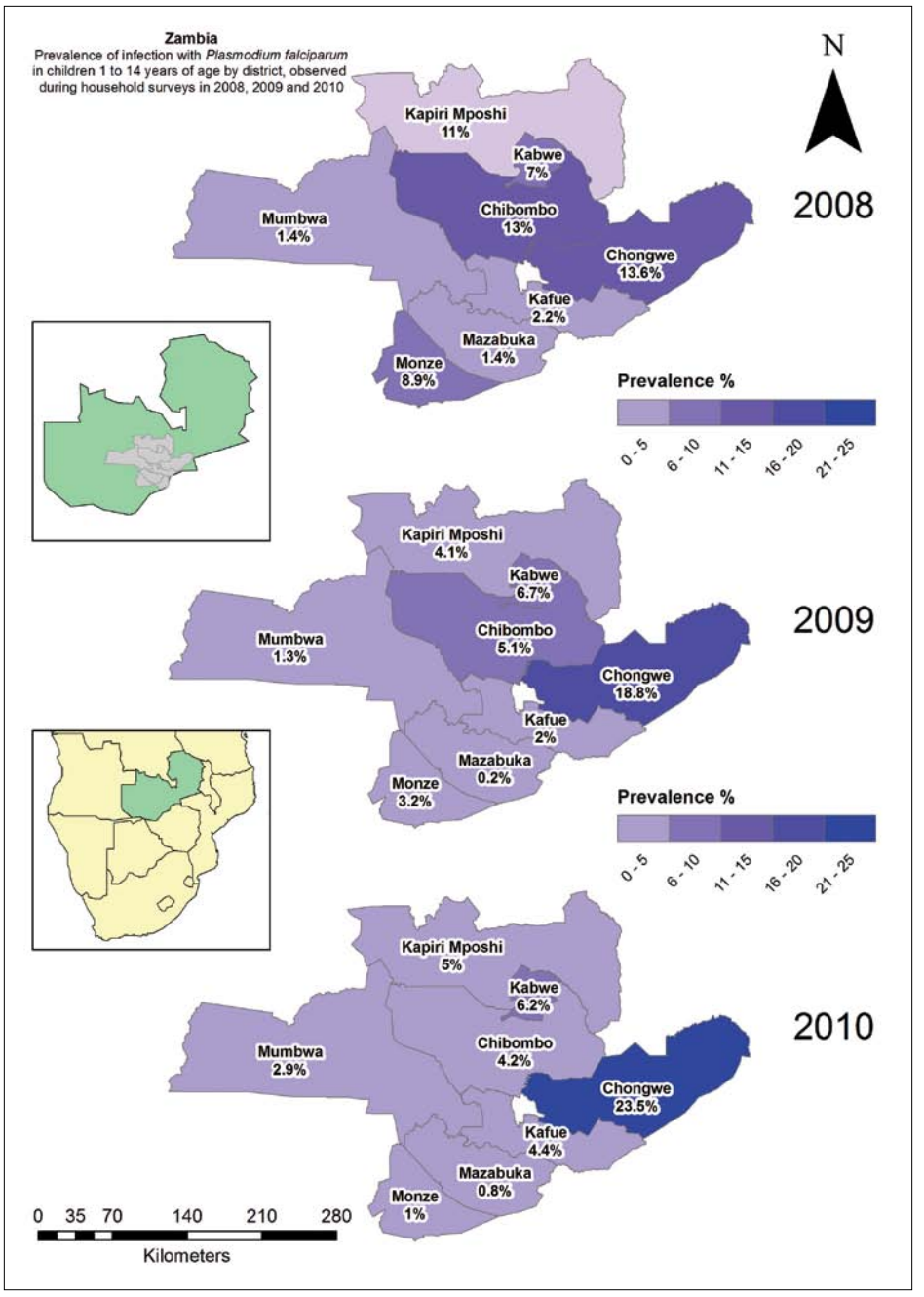
Zambia has a population of approximately 12 million people, 45 percent of whom are under 15 years of age. Malaria is endemic countrywide, and its transmission occurs throughout the year, with a peak in the rainy season. The disease is the leading cause of morbidity and mortality, accounting for 40 percent of outpatients and 45 percent of hospital admissions, with 47 percent and 50 percent of disease burden, respectively, among pregnant women and children under five years of age. Current trends in the country indicate that malaria is responsible for at least 3 million clinical cases and about 6,000 recorded deaths annually, including up to 40 percent of the under-five deaths and 20 percent of maternal mortality.

Since malaria is not evenly distributed, much effort needs to be expended toward defining the local spatial distribution of the disease before the deployment of vector control intervention measures (i.e., indoor spraying and the distribution of insecticide-treated nets [ITN]) in accordance with World Health Organization (WHO) protocols. Furthermore, insecticide resistance is a growing problem that must be factored into decisions.

However, in resource-constrained environments, monitoring and evaluation are often neither thorough nor regular and tend to lack the important spatial and temporal distribution patterns. Therefore, if transmission-determining parameters are to be harnessed effectively for decision making and objective planning, implementing, monitoring, and evaluating viable options for malaria vector control, those parameters must be well organized, analyzed, and managed in the context of a GIS-based decision support system (DSS).

The usefulness of an ArcGIS software-based DSS for planning and managing control programs is, of course, dependent on the availability of accurate and raw data on malaria transmission-related parameters. The monitoring and evaluation of malaria interventions and an understanding of their true impact on disease burden are essential for measuring the performance of a control program.

The ability of the DSS to deal with large datasets and incorporate maps, satellite images, and aerial photos increases the feasibility of studying transmission determinants of malaria and has resulted in the prompt availability of data to support surveillance and policy formulation. The epidemiological mapping of high-risk areas of malaria transmission and the insecticide resistance profiles of major vectors has facilitated the recognition of those populations and geographic areas where it is possible to identify the main determinants of malaria morbidity and mortality. The revealed trends and interrelationships have allowed the identification of high-risk areas and facilitated decision making and the rational utilization of limited resources for targeted, high-impact interventions in a cost-effective manner.



The prevalence of infection with *P. falciparum* in children 1 to 14 years old as observed during the annual parasitemia surveys from 2008 to 2010 by district.

Receiving a shipment of insecticide-treated nets is cause for celebration.

Herein is provided a review of data related to the operational use of a GIS-based DSS for optimal deployment, monitoring, and evaluation of entomological interventions for malaria control in Zambia.

Intervention

Indoor residual spraying (IRS) of a variety of insecticides in urban areas is implemented through annual campaigns, with 85 percent coverage of eligible households at the beginning of the peak malaria transmission period. ITNs are deployed in rural areas through antenatal and child clinics, equity programs, community mass distribution, and the commercial sector and strive toward attaining 100 percent coverage in eligible areas.

Stratification

The protozoan parasite *Plasmodium falciparum* accounts for 98 percent of all malaria infections in the country, causing the severest form of the disease. The national malaria indicator survey for 2010 in children under five years of age shows great spatial variance in the prevalence of infection.

This has resulted in the stratification of the country into three epidemiological categories:

- Type 1 areas with very low transmission and parasite prevalence of less than 1 percent
- Type 2 areas with low transmission and prevalence of less than 10 percent
- Type 3 areas with persistent high transmission and prevalence exceeding 20 percent at peak transmission season

Malaria stratification aids in the development of community-based malaria control programs by accumulating past experiences with and solutions to different factors associated with malaria outbreaks. Stratification can also point to the existing inequalities in resources, allowing for a more equal and homogeneous distribution of available resources.

GIS-Based Sentinel Sites

In this regard, to allow for adaptation of intervention policy, procedures, and methods to better the outcomes, vector control interventions on parasite prevalence in children between 1 and 14 years of age have been monitored through annual malaria surveys for three

consecutive years at 19 GIS-based sentinel sites, distributed among nine districts within a 350-kilometer radius of the capital, Lusaka. These sites were established for the continual monitoring and collation of key malaria data, such as parasitemia risk, insecticide resistance profiles in vectors, and impact of interventions on malaria prevalence. The use of the GIS-based DSS has allowed the identification of areas that require specific targeted intervention for impact, either through the use of ITNs or IRS or a combination of both.

Spatial Monitoring of Interventions

The spatial and temporal impact of indoor spraying and insecticide-treated nets on human parasite prevalence and insecticide resistance status in major malaria vectors was monitored. At each sentinel site, household surveys were carried out annually from 2008 to 2010 to measure *P. falciparum* prevalence in children aged 1 to 14. In Zambia, three nationally representative malaria indicator surveys (MISs) were also conducted in children under five years of age in 2006, 2008, and 2010. The MISs have been used to estimate an empirical high-resolution parasitological risk map in the country and assess the relationship between malaria interventions and parasitemia risk. The spatial impact of interventions and the overall prevalence of infection are as follows:

- Children who lived in a house that had not been sprayed in the past year and did not sleep under a net the night before the survey had a prevalence of infection of 6.8 percent.
- Children who slept under a net but lived in a house that had not been sprayed during the past year had a prevalence of infection of 5.2 percent.
- Children who lived in a house that had been sprayed during the past year but did not sleep under a net had a significantly lower prevalence of infection of 3.2 percent.
- Children who slept under a net in a dwelling that had been sprayed had the lowest risk of infection, with a prevalence of infection of 2.6 percent. Thus, an incremental effect was observed for the combined use of IRS and ITNs.

Spatial Distribution of Insecticide Resistance Profiles

The ArcGIS software-based DSS has been used to collate data on insecticide resistance in Africa. By standard WHO protocol, the spatio-temporal insecticide resistance profiles of major malaria vectors—*Anopheles gambiae s.s.*, *An. arabiensis*, and *An. funestus*—were determined at sentinel sites and extended to other regions of the country. More data on the spatial distribution of resistance to five different insecticides has been collected by different partners and collated by the National Malaria Control Programme. Data on suspected and overt resistance to insecticides is being harnessed for vector control. The marked insecticide resistance problem in indoor spraying sites confirms other findings of resistances developing in the wake of extensive vector control. This allows the malaria control program manager to better utilize the limited resources on insecticides to which the malaria vectors are still susceptible. Detection of high resistance levels has facilitated the planning of rational insecticide resistance management strategies and the introduction of alternative non-insecticide-based vector control interventions.

In Zambia, monitoring the impact of vector control through a GIS-based decision support system has revealed a change in the prevalence of infection and vector susceptibility to insecticides and has enabled measurement of spatial heterogeneity of trend or impact. The revealed trends and interrelationships have allowed the identification of areas with reduced parasitemia and increased insecticide resistance, thus demonstrating the impact of resistance on vector control. The GIS-based DSS provides the opportunity for rational policy formulation and the cost-effective utilization of limited resources for enhanced malaria vector control.

Conclusion

Routine surveillance data has proved inadequate for monitoring control programs and is presently being supplemented by parasite prevalence surveys; vector-borne diseases demonstrate decided geographic heterogeneities and therefore require special tools for analysis. With its inherent ability to manage spatial data, GIS provides an exceptional tool for continuous surveillance and a framework for harmonizing surveillance data and parasitemia survey data. At a regional level, the ability of GIS to display data in an intuitively understandable manner has been harnessed to establish a continental database in Africa of the spatial distribution of malaria. The GIS-based DSS has not only streamlined the evidence-based implementation of intervention measures but has also improved the tracking of entomological indicators: species characterization and insecticide resistance status, including parasite prevalence and impact assessment of ITNs and IRS. For resource-constrained malaria-endemic sub-Saharan African countries like Zambia, the need for a GIS-based malaria information system cannot be overemphasized. Until recently, decisions in the malaria control programs were taken on an ad hoc basis driven by limited empirical evidence, undoubtedly resulting in the misdirection of the limited available resources.

Indoor residual spraying is implemented through annual campaigns with 85 percent coverage at the peak malaria transmission period.

The mosquito—a major malarial vector.

For more information, contact Victor Munyongwe Mukonka (e-mail: vmukonka@gmail.com).

About the Authors

Emmanuel Chanda of the National Malaria Control Centre, Ministry of Health, Lusaka, Zambia, coordinated and participated in data collection, analyzed the data, and drafted this article. Victor Munyongwe Mukonka, also of the Ministry of Health, and Mulakwa Kamuliwo of the National Malaria Control Centre, Ministry of Health, were both responsible for management of the project and contributed to the drafting and critical evaluation of the paper article. David Mthembu and Sarel Coetzer of the Malaria Research Programme, Medical Research Council, Durban, South Africa, participated in field survey data collection and mapped the sites. Cecilia Jill Shinondo of the School of Medicine, University of Zambia, contributed to the drafting, review, and critical evaluation of the article.

World Health Decision Makers Should Consider GIS

By Daniel J. Carucci, MD, PhD, President, Global Health Consulting, Inc.

Over the past decade, development assistance for health (DAH), including that targeting malaria control across Africa, has increased significantly from $7 billion a year to $27 billion a year in 2007. Those investments have resulted in millions of lives saved, including a nearly 50 percent reduction in deaths due to malaria in some countries. Continued progress toward reaching the audacious goals established by the United Nations—to reduce childhood mortality by two-thirds and the maternal mortality ratio by 75 percent and halt the advance of the HIV epidemic—will require not only additional funds but also smarter approaches to delivering lifesaving resources to those who need them most.

The populations who are affected by these health concerns are not distributed evenly across countries, and, unfortunately, neither are the resources, commodities, and services that they need. Malaria rates are highest near areas of stagnant water that come about during periods of heavy rain or as a result of man-made irrigation and are lowest at higher elevations and in arid conditions. Similarly, HIV rates may be higher in certain urban populations sometimes associated with commercial transportation routes. Tuberculosis can be found in hotspot areas, where crowded conditions and remote location can increase transmission and hinder detection and treatment. Maternal and neonatal mortality are highest in rural populations that have little access to preventive services and emergency care.

Health ministers are faced with the enormous challenges of providing health care products and services, such as insecticide-treated bed nets to prevent and kill malaria-carrying mosquitoes, anti-retroviral drugs to prevent and treat HIV infection, condoms to prevent sexually transmitted diseases and unwanted pregnancies, drugs to treat tuberculosis, family planning services, and childhood vaccines. Existing health systems and the supply chain infrastructure are fragile and poorly distributed throughout the country, meaning that more effort is required to get goods and services to those most affected. Decision makers must have better tools and knowledge to ensure that the substantial but limited resources that are available are allocated where they are needed most. They also have to be able to evaluate the impact that their policies and resource allocation decisions are having on vulnerable populations. Finally, donor governments need greater transparency from recipient countries to determine the impact and outcomes of their investments, particularly as funding for international assistance comes under greater scrutiny.

By harnessing geospatial information with the vast quantities of data that have been generated over the past decade; encouraging newly collected data to be geopositioned; and combining disparate datasets from satellite imagery, weather, environment, elevation, transportation corridors, epidemiology, resource allocation, training programs, and others, health ministers and donors will be able to evaluate the effectiveness and efficiency of their health strategies. Importantly, it will allow them to make near real-time adjustments in their strategies and more effectively deploy their resources to those most in need, as the authors of the above article have done.

The GIS community needs to work to close the gap between the technical staff that are fully immersed in GIS for health and the policy and decision makers who may not yet fully appreciate the importance and power of GIS in their decision making or for strengthening their advocacy for continued resources from donor governments.

For more information, contact Daniel Carucci, president, Global Health Consulting, Inc. (e-mail: dan@globalhealthconsulting.com).

Lost and Found in the Polish Carpathian Mountains

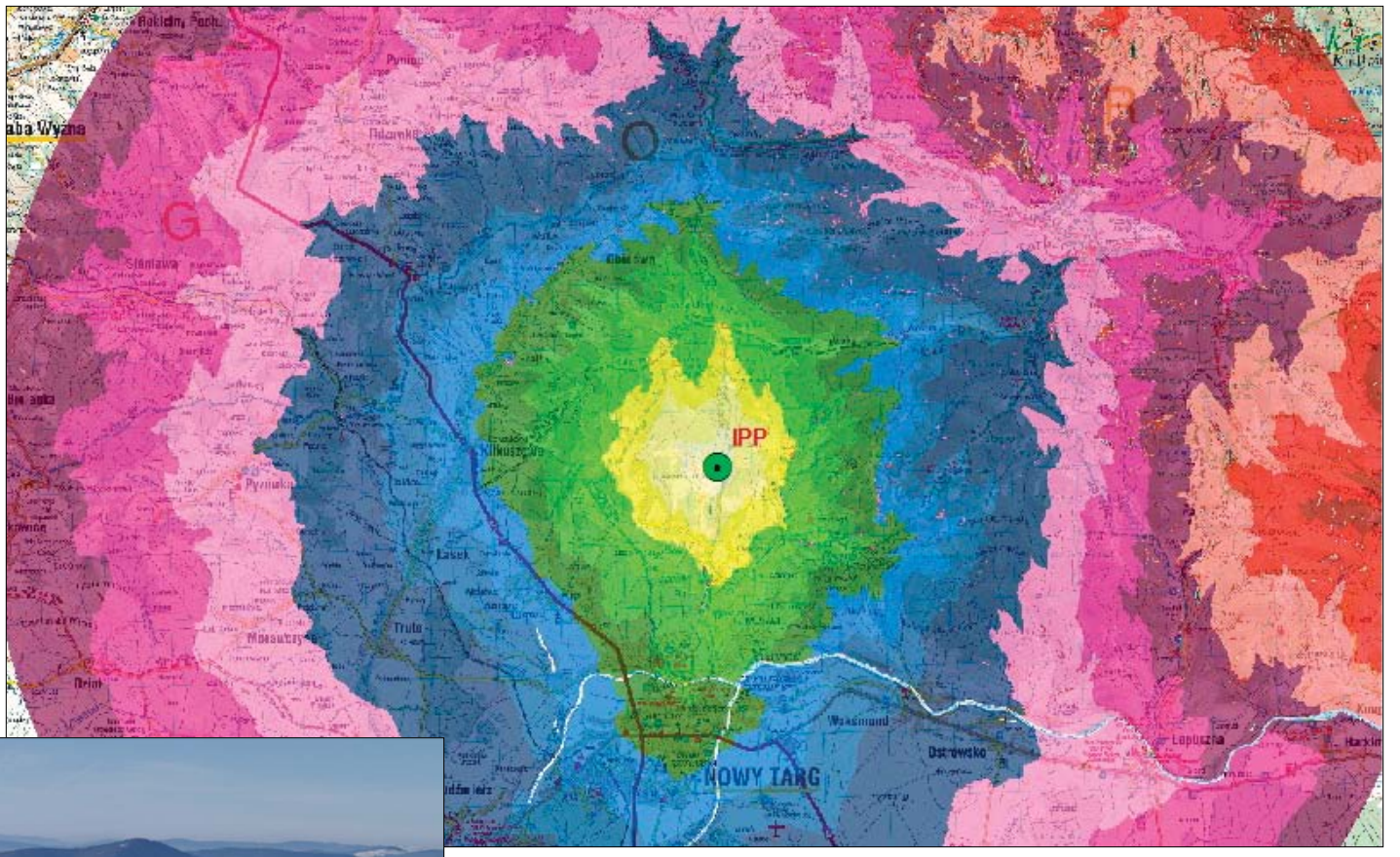
GIS-Based Analysis Is Aiding the Search, Rescue, and Safe Return of Lost Hikers

By Elżbieta Filipkowska, with Robert J. Koester, Rafał Chrustek, and Mariusz Zaród

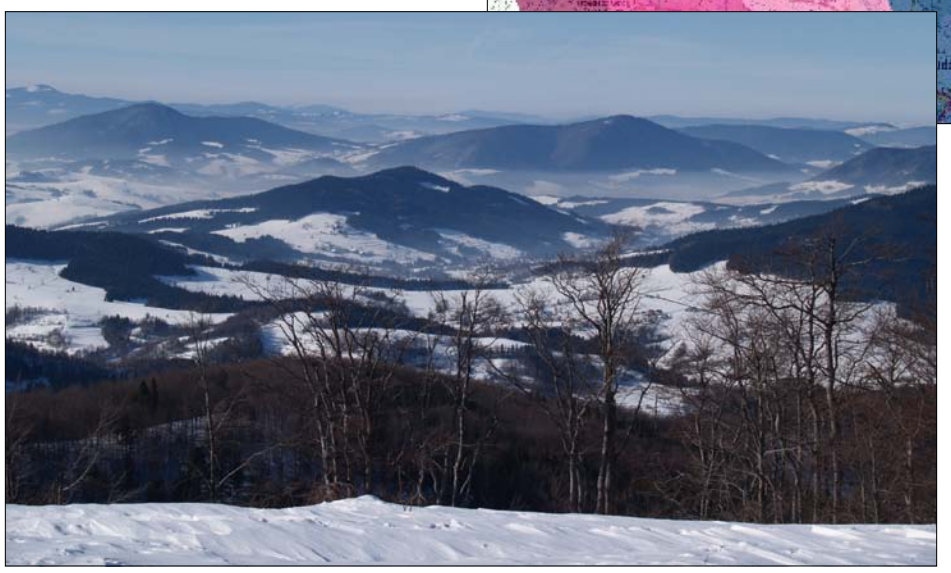
Highlights

- Search and rescue are managed with ArcGIS and integrated navigation and communication solutions.
- ArcGIS for Server helps determine exploratory areas and routes and publish them to PDAs.
- With GIS, rescuers conduct statistical analysis to determine the likelihood of finding missing persons in specific locations.

The Search and Rescue Mountain Team for the Polish mountains consists of seven regional groups. The work area of one of these groups—the Podhalańska Group (PG)—includes the Outer Western Carpathian Mountains (Gorce, Beskid Wyspowy, Pasmo Polic, Orawy, part of Beskid Sądecki, and Beskid Makowski) and the Central Carpathian Mountains (Pieniny). This area consists of 4,200 square kilometers, with 1,500 kilometers of hiking trails, 50 ski lifts, and peaks rising up to 1,400 meters above mean sea level.



The GIS enables creation of the areas of mobility—in this case, 15-minute-interval zones.



Mountains in the Podhalańska Group area of exploration. (Photo: Podhalańska Group.)

PG unites 360 rescuers, including 33 instructors and 16 professional rescuers. Every year, PG rescuers are involved in about 700 actions, expeditions, and interventions, including dozens of exploratory expeditions. The search and rescue expeditions in the region's mountains, forests, and valleys mainly involve lost hikers, the injured (e.g., forest workers), the elderly, children (6–12 years old), the mentally ill, people with Alzheimer's disease, and suicides.

In Rabka-Zdrój, the spa town in southern Poland where PG's headquarters is located, staff and rescuers perform analysis of both terrain and the behavior of those who are lost (based on psychological profiles) to assist in the selection of search and rescue tactics. Aerial photos and orthophotos; statistics; and information about road networks, watercourses, and land cover and its configuration are analyzed by PG.

PG efforts are managed using ArcGIS software in conjunction with integrated navigation and communication solutions. The implementation of GIS is a result of PG instructors' intense study and development of the command and control system. The choice of ArcGIS software was made based on the recommendation of a PG rescuer (who is a current PhD student with a passion for GIS). The implemented solutions enable rescuers to conduct analyses and use the statistics in real time during operations.

Podhalańska Group's GIS

The stationary command post at Rabka-Zdrój allows PG rescuers to handle GPS data transmitted from the communication module to the database. The data is presented in the system so as to clearly identify the ID device type and its position. Rescuers' positions are mapped as determined by GPS receivers embedded in mobile radios, as well as PDAs, web tracking devices, and mobile command stations.

The GIS enables PG to determine exploratory areas and routes and publish them to PDAs using ArcGIS for Server. In the course of exploration, the rescue commander can monitor the route and the last known location of GPS-equipped mobile devices. It is also possible to check the previous locations for any time interval. This facilitates marking areas that have already been checked. In the case of expeditions that do not require coordination in the field, the action is managed only from the stationary command post.

In addition to the stationary command post, PG has a vehicle-mounted mobile command station. It is fully equipped with a notebook computer loaded with software for monitoring the current position of each GPS device. The position of the PDA is transmitted via the Global System for Mobile Communications (GSM) network to a server system at the headquarters. In addition, the PDAs have software to restore routes or other areas of exploration, perhaps provided by the commander of the rescue operation, in the form of a vector map layer. The current position of rescuers on the GIS map can also be presented so the commander of an operation can observe rescuers' movements within the exploratory area and thus better manage the action. Since the mobile command station is equipped with ArcGIS software, it can be used to perform most of the same activities as the stationary command post (with the exception of 3D analysis). This makes it possible to conduct a rescue action independently.

In addition to communication via the GSM network, the system can handle, on the server-side application, GPS positions from mobile radios.

Moreover, rescue dogs used in areas inaccessible to rescuers are equipped with telemetry collars so rescuers can follow their locations on their mobile devices.

GIS and Search and Rescue Action Planning

The information about the position of rescuers in the exploration area, obtained from GPS receivers, is critical, especially for the commander. An appropriate distribution of rescuers may enhance the accuracy of exploration within the area and increase the likelihood of finding a lost person.

In 2002, PG developed an exploratory method called "fast three." In this method, the rescuers are divided into groups of three, and one of the rescuers in each group is equipped with a GPS device. The advantage of such a setup is primarily to allow rescuers to choose routes to explore in the course of the action, because the rescue team has no delimited route before the exploration.

Statistics in Exploratory Analyses

PG's GIS not only enables exploratory route planning but also allows rescuers to analyze various aspects of a disappearance incident in terms of spatial reference (the analyses can be displayed on the map). The PG database was created based on the International Search & Rescue Incident Database (ISRID), which includes 41 categories of exploration (e.g., hikers, autistics) and more than 50,000 disappearances. The statistics in ISRID are described by Robert J. Koester in *Lost Person Behavior*. The database used by PG has been adapted to Polish conditions [*see sidebar in the online version of this article at* **esri.com/arcnews**].

Summary

Development of GIS technology allowed Podhalańska Group to use a modern system that provides remote monitoring of rescuer positions on a map and assign them jobs and routes within a search area. In addition, the use of the capabilities of Esri ArcGIS software enables Podhalańska Group rescuers to conduct statistical analysis to determine the likelihood of finding the missing person in a specific location.

Data implemented in the GIS, such as layers of roads and drainage, can be used in subsequent actions, which can significantly accelerate the rescue operation and thus increase the likelihood of finding a lost person.

About the Authors

Elżbieta Filipkowska is GIS specialist and a graduate of Geographic Information Management at Cranfield University (United Kingdom) and Environmental Protection at Warsaw University of Life Sciences (Poland). Robert J. Koester is CEO of dbS Productions. Mariusz Zaród is head of Podhalańska Group of Search & Rescue Mountain Team. Rafał Chrustek is a GIS analyst and deputy head of Podhalańska Group.

For more information, contact Elżbieta Filipkowska (e-mail: e.filipkowska@hotmail.com), Robert J. Koester (e-mail: Robert@dbS-sar.com), or Rafał Chrustek (e-mail: rchrustek@gopr-podhale.pl). The Search and Rescue Mountain Team received Esri's Special Achievement in GIS (SAG) Award at the 2012 Esri International User Conference.

Electric Utility's Dynamic Duo—SCADA and GIS

iPhone Application Mitigates Blackouts Due to Overhead Lines Affected by Strong Storms or Freezing Rain

Highlights

- An iPhone application uses GIS to check out-of-service stations and the number of affected customers.
- The GIS department displays SCADA information directly on a map.
- Changes in the network are propagated from the GIS to the SCADA system as a full update.

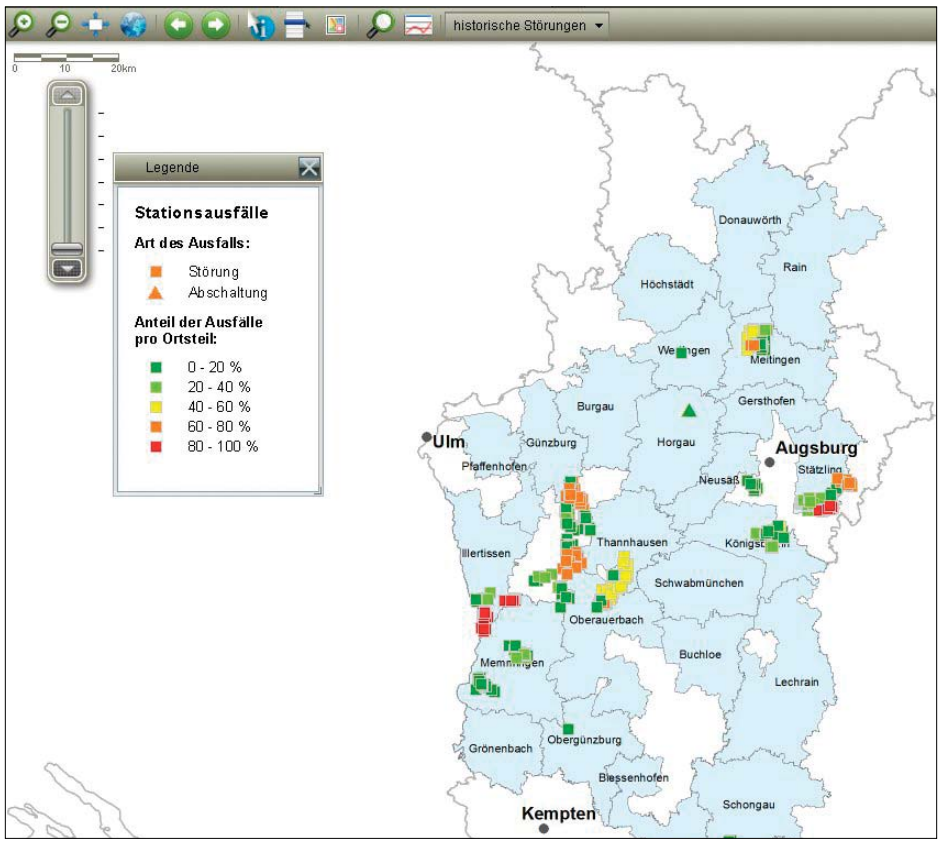
Lechwerke's overhead lines are vulnerable to natural hazards, such as strong storms or freezing rain, that have the potential to result in blackouts for customers.

Known for medieval castles, snowcapped mountains, and world-famous beer gardens, the southeast German state of Bavaria aims to blend traditional with modern. Bavaria is home to Munich and is the largest German state by area and second most populous, with more than 12 million inhabitants and a steady stream of tourists.

Electric power is provided to part of this popular and well-populated region by Lechwerke, a Germany-based electric utility company. Lechwerke distributes electricity through low-, medium-, and high-voltage grids; generates electricity through 35 hydroelectric power stations; and is engaged in electricity trading, electricity and gas sales, and energy efficiency services.

Management at Lechwerke ensures reliable service by using an iPhone application to check out-of-service stations and the number of affected customers. The application is made possible by excellent data quality, a well-defined and stable data model, and a tight integration of GIS and the company's supervisory control and data acquisition (SCADA) information system.

The GIS department of Lechwerke has ambitious visions and a focused long-term plan that emphasizes data quality and system integration. Lechwerke's overhead lines are more vulnerable to natural hazards, such as strong storms or freezing rain, that have the potential to result in blackouts for customers. In these types of crisis situations, Lechwerke management works to curtail the impact on customers by minimizing the outage duration and number of customers affected.



Lechwerke lessens the impact of natural hazards, minimizing the outage duration and number of customers affected. Here is a station outage situation on May 26, 2009, at 1815.

Traditionally, management would request information about the degree of the crisis in the SCADA control center—the only place where all information came together. But the staff in the control center in a crisis situation is extremely busy attending to calls from the field and working to restore electricity to customers.

Staff in the GIS department decided it would be prudent to take the information provided by SCADA and display it directly on an ArcGIS software-based map, accessible via the iPhone application. For its documentation, the company uses the ArcFM UT product line, a solution developed by Esri Partner AED-SICAD (Bonn, Germany) using ArcGIS technology from Esri. Whenever there is a change in the network, the change is propagated from the GIS to the SCADA as a full update. Updates take roughly 40 minutes. A visual control is done before making the change live.

This process brought several key advantages. Data must be entered in only one system. Errors in the old schema plan of the control center were detected. And all assets have the same unique ID in the GIS and the SCADA.

Having in mind that the stations in the SCADA and the GIS "know" each other, it was not a big step to use the same robust ASCII interface of the SCADA to send an ASCII file containing the status messages from the SCADA to the GIS every three minutes. Via SQL, this list was filtered and aggregated to obtain one SQL record containing only key information per outage. This record is then written to an Esri feature class and displayed in a small application.

Through a visual web interface, the end user (in a crisis situation, this would be the company CEO) can select a certain theme, such as outages, and receive an overview of the distribution area. All out-of-service stations are displayed in colors ranging from green to red depending on the percentage of the affected district or city. Key attribute information is also available from the map view. Once data is in the GIS, it can be accessed using the iPhone application.

This web solution was implemented by AED-SICAD subsidiary and Esri Partner BARAL Geohaus-Consulting AG (Reutlingen, Germany). It used ArcGIS for Server together with the brand-new ArcFM UT Server V10 JavaScript client, caching all basemap data, only providing out-of-service stations and the geoschematic layer as dynamic layers. Basemap data is displayed instantaneously, and the dynamic layers are visible after an approximate five-second delay.

"If you want to bring new apps to your end users, they must be better than the old ones," says Martin Thoma, GIS manager at Lechwerke. "Here, we have brought completely new information content paired with greatly improved performance through the latest ArcGIS technology. Thus, we could achieve end-user acceptance of this new technology."

Thoma is convinced that SCADA and GIS will continue to grow together in the near future. He sees this type of integration as the productive basis for implementing lightweight and rapidly developed web interfaces, which bring users exactly the content and functionality they need for a certain task. But Thoma stresses the fact that the fundamentals must be there: the good, stable, and well-known UT data model; excellent data quality; and the combined know-how of IT and utility business processes.

For more information, contact Martin Thoma, Lechwerke (e-mail: martin.thoma@lew.de), or Peter Grüninger, BARAL Geohaus-Consulting AG (e-mail: peter.grueninger@baral-geohaus.de).

EPA Builds Map Service on ArcGIS Online for Organizations

Highlights

- The ArcGIS Online infrastructure is customized for EPA internal GIS cloud-based service.
- The agency web platform contains security tools.
- The self-service environment helps users search for web maps and consume data from inside and outside the agency.

The United States Environmental Protection Agency (EPA) has worked with Esri through many cycles of technical development over the past 25 years. With each cycle, the prevalence of GIS tools and applications has grown within the agency. Today, the EPA is a federal showcase of GIS web applications, such as its Environmental Dataset Gateway, Facility Registry Service, and EnviroMapper.

Esri's most recent technological cycle includes ArcGIS Online, which is a cloud-based, collaborative content management system for maps, applications, data, and other geospatial information. EPA saw the web service infrastructure as a viable means of publishing its own data and tools and making them even more accessible to managers and staff.

In May 2012, EPA launched EPA GeoPlatform based on Esri's ArcGIS Online for Organizations. EPA GeoPlatform is a framework for coordinating geospatial activities, applications, and data across the agency. EPA administrators announced that EPA GeoPlatform is available to every EPA employee as a foundation for all the agency's geospatial applications. Its policy now is that all geographic data and tools be built on EPA GeoPlatform.

Administrators also cited benefits of EPA GeoPlatform, including increased access to place-based decision-making tools, a standardized look and feel for map products, and applications supported by a core set of national data services. It eliminates redundancy in deployment and use of GIS, which leads to cost savings.

"Applications, data, and models served on EPA GeoPlatform help people do their jobs better and enhance environmental decision making," says Harvey Simon, EPA's acting geographic information officer.

The agency-wide web mapping service allows EPA to use the Esri-hosted infrastructure in a managed, secure, and scalable cloud-based environment. EPA retains control of the service and security to administer role-based members and public and private groups. It can track usage and monitor storage and reports.

EPA GeoPlatform includes three components: a public GIS cloud subscription service for accessing data and building web applications, a private cloud configuration for sharing data internally using role-based security, and data and application services built and distributed on its GIS server infrastructure in both public and private environments. It employs cloud service tools, viewers, and applications from ArcGIS Online, Community Analyst, and ArcGIS Explorer Online to make geospatial analysis more mainstream within the agency.

EPA GeoPlatform supports EPA enforcement targeting, community-based grants analysis, and environmental justice screening. It also provides a wide range of data, applications, and maps to support its staff's community-based work.

Users work in a self-service environment to search for web maps and consume data from EPA's dataset gateway, as well as from data .gov and ArcGIS Online. EPA GeoPlatform has a metered service so that the agency can watch traffic and load on its servers and respond by dynamically increasing or decreasing service support. The EPA map store helps staff members discover or publish web maps so that others can use them. Using a public-facing viewer, citizens can add their data to a map and use that map to support discussion.

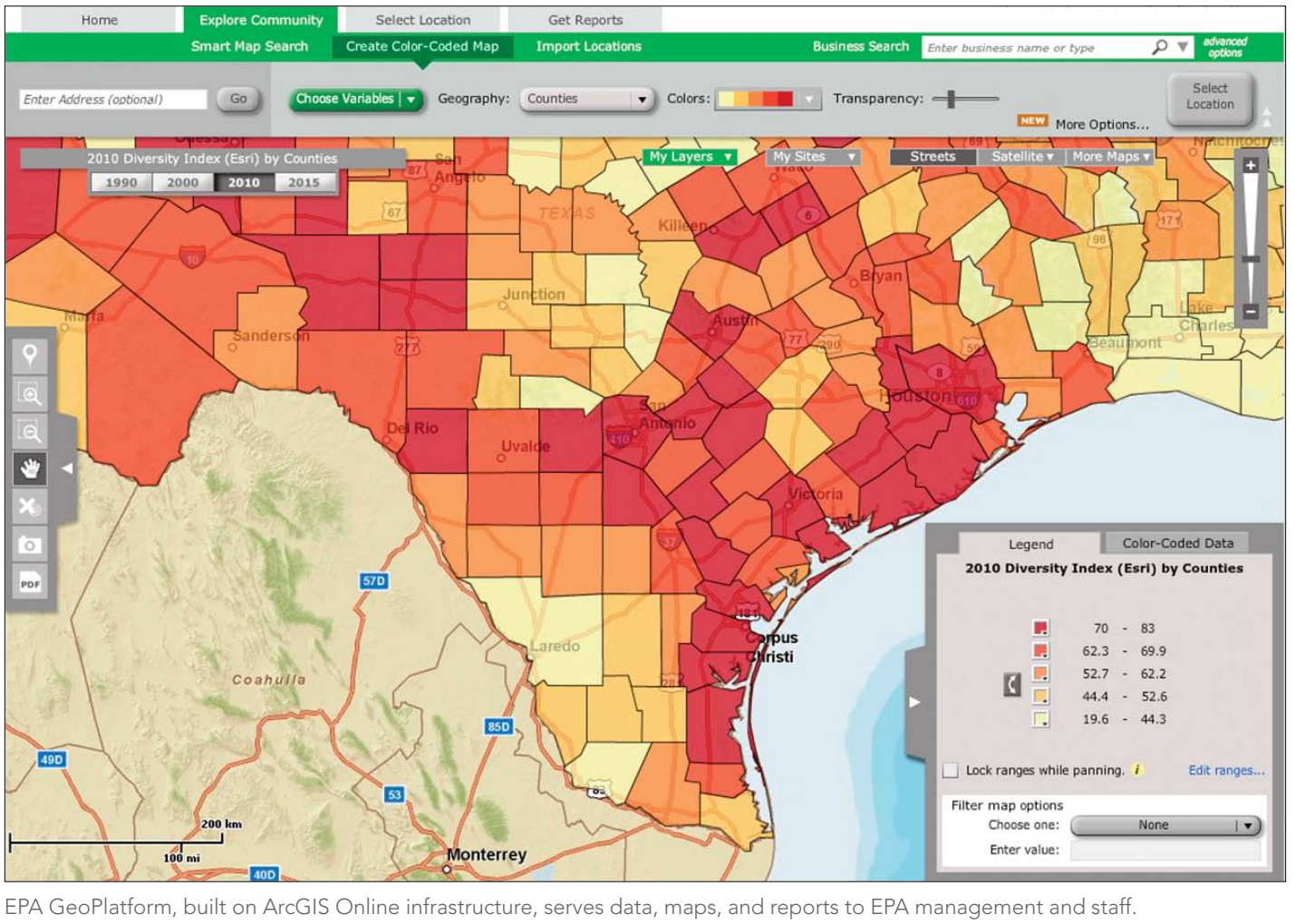
Looking Forward

EPA is in the process of customizing Esri's ArcGIS Explorer as a viewer that integrates EPA GeoPlatform data and services and environmental queries and models. Staff will use it to add data, such as demographic variables and particulate matter, ozone, and chemical data, to maps. Eventually, the viewer will be installed on all agency desktops. EPA also plans to customize the full ArcGIS desktop client to provide agency GIS capabilities.

Working with Esri, EPA is customizing a version of Community Analyst called Environmental Analyst. It adds hundreds of EPA data layers to Esri's thousands of demographic, health, economic, education, and business data layers. Staff will be able to ask questions, such as, Where should I target environmental enforcement actions? Does the area around a chemical facility have potential environmental justice concerns? What is the violation history of this dry cleaner?

EPA GeoPlatform is at the center of EPA's hosted map services.

For more information, contact Latisha Petteway, press officer, United States Environmental Protection Agency (e-mail: petteway.latisha@epamail.epa.gov).



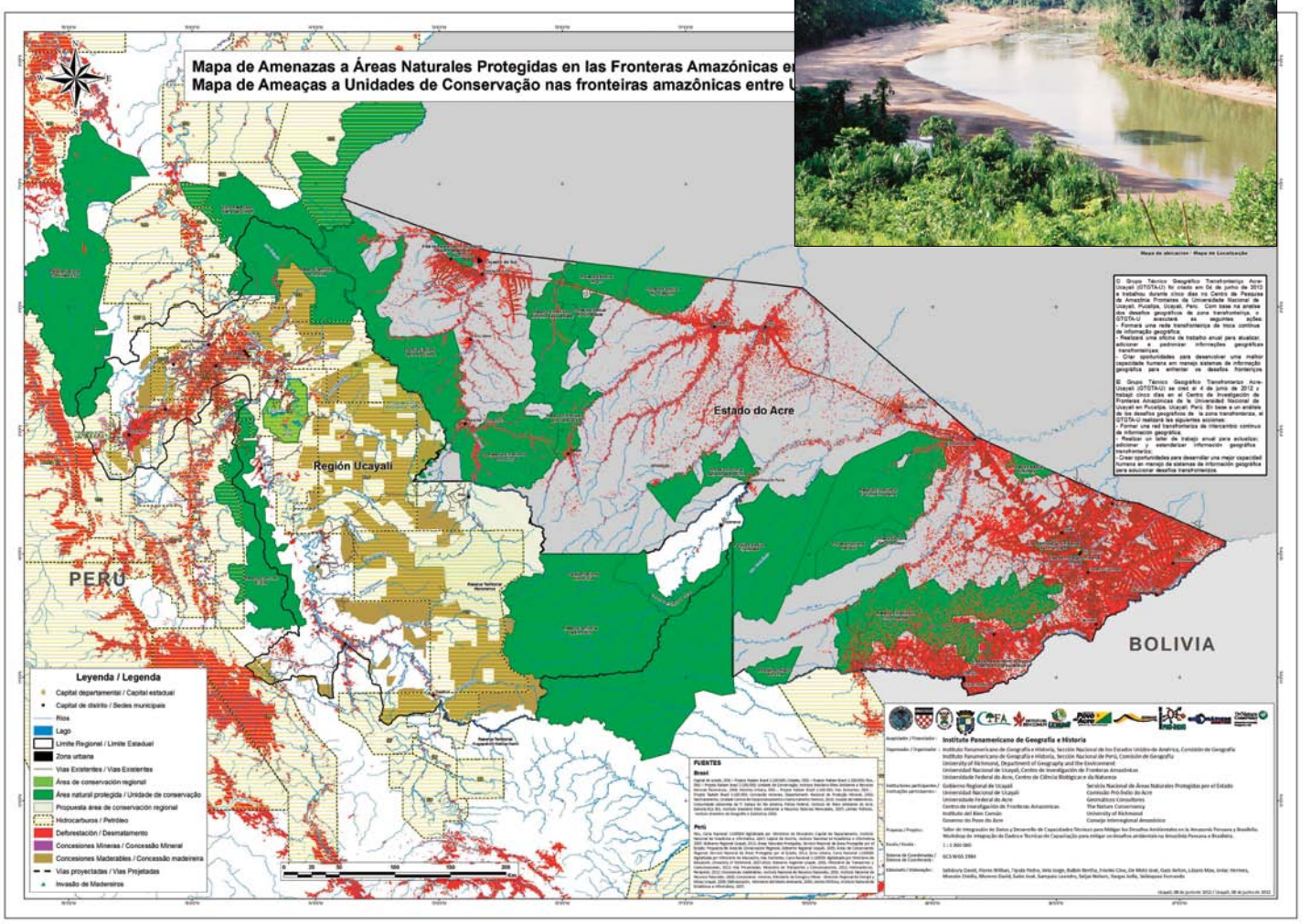
EPA GeoPlatform, built on ArcGIS Online infrastructure, serves data, maps, and reports to EPA management and staff.

Amazonian States Map Threatened Borderlands

By David S. Salisbury, A. Willian Flores de Melo, Jorge Vela Alvarado, and Bertha Balbín Ordaya

Highlights

- GIS provides a common language and shared framework regardless of national sovereignty or borders.
- Amazonian policy makers use ArcGIS to understand the geographic reality of remote borderlands.
- Scientists use ArcGIS to identify transboundary threats to Amazonian biologic and cultural diversity.



ArcGIS is used to create a thematic map showing threats to protected areas. **Inset above:** A river in the transboundary region.

The 800 kilometers of boundary separating the Peruvian region of Ucayali from the Brazilian state of Acre crosses some of the wildest landscapes left on earth. The lush rain forests of this borderland region still resound with the low grunt of jaguar, while their canopy sways with acrobatic troops of woolly monkeys. Underneath the canopy roam hundred-strong herds of white-lipped peccary and the elusive and elegant ocelot.

This biodiversity inspired parks such as the Sierra del Divisor, Alto Purús, and Chandless reserves, but these forests also hold humans. The "uncontacted" Mashco Piro, Murunahua, and Isconahua indigenous people still move stealthily through the trees, seeking no contact from outsiders or their goods other than the occasional machete. As these people migrate through their reserves and neighboring parks, other traditional peoples, such as the Ashéninka, Yaminahua, and descendants of rubber tappers, live along neighboring rivers and adjacent lands. More recent arrivals include loggers, miners, and drug traffickers seeking to exploit these remote areas for high-value timber, minerals, and trafficking routes.

Improving Transboundary Planning

Recently, the Regional Initiative to Integrate South America has begun promoting a transboundary road that would bisect the forested borderlands and connect the two largest cities in the region, while the state governments seek to promote a direct ecological railroad alternative. Both transportation initiatives promise to alter forests and rivers and transform economies and cultures, but these projects also lack the base geographic information necessary to understand their potential transboundary impacts and benefits.

To improve transboundary planning, a grant from the Pan-American Institute of Geography and History was obtained to lead the Workshop to Integrate Data and Improve Technical Capacity to Mitigate Environmental Challenges in the Brazilian and Peruvian Amazon in June 2012.

The workshop used GIS as a common language and shared framework to bring together 16 GIS professionals from 13 institutions and two different countries to the National University of Ucayali (UNU) in Pucallpa, Peru. Each of the participants relied on ArcGIS in its home institution and brought work laptops to allow maximum flexibility for organic group work within UNU's Amazon Borderlands Research Center.

Bringing Diverse Areas Together

In the last decade, the Brazilian and Peruvian states have increasingly targeted the borderlands for conservation and development projects but with almost no knowledge of what lies on the other side of their respective boundaries. At the same time, the impacts of illegal logging and drug trafficking have spilled across borders, causing damage to the environment, local livelihoods, and diplomatic relations.

During this weeklong workshop, participants used ArcGIS to create a database and representative map integrating spatial data from both countries. However, before beginning the technical workshop, participants and invited speakers held a conference to educate the public and local policy makers on the importance of geographic information for conservation and sustainable development. Indigenous leaders, university professors, GIS technicians, nongovernmental organization directors, and government officials shared their insights:

- How ecological and cultural diversity permeate international boundaries
- How the environmental challenges on both sides of the boundary are similar
- How local and indigenous populations have been historically marginalized in the borderlands despite their local knowledge and leadership potential to reach transboundary sustainability goals

The conference ended with all participants empowered by the importance of the workshop in providing the information necessary to make informed decisions about natural resources management, development, and conservation along and across political boundaries.

A Common Platform to Standardize Management

Despite their enthusiasm, participants quickly faced numerous challenges, such as different spatial representations of their international boundaries; outdated national datasets; low-quality and missing geographic information; and data with variable scales, datums, and projections. Undaunted, the assembled GIS technicians utilized ArcGIS to standardize the best available data. The participants decided their efforts would focus on creating a capacity-building process and products for improved transboundary management rather than one flawless map. To this end, they divided into three mapmaking groups: threats, protected areas, and ethnogeography.

Each group contained representatives from both Brazil and Peru and used ArcGIS as a common language and arena to make the important decisions necessary for transboundary mapmaking. At the conclusion of the five-day workshop, the interdisciplinary team of participants named itself the Acre-Ucayali Transboundary Geography Working Group and held up three unique transboundary maps as examples of its craft and camaraderie. However, the greatest result of the workshop was the formation of a transboundary network of professionals taking the first step toward an integration based on geographic understanding rather than speculation and uncertainty.

To continue building on the workshop, the participants signed a document declaring their intention to meet annually to continue to build a transboundary network of geographic information interchange and improve the technical capacity to solve transboundary socioenvironmental challenges. A week following the declaration, the governor of Ucayali underscored the utility of the workshop by using the workshop maps in a presentation to Brazilian, Bolivian, and Peruvian delegates at a Pan-Amazonian seminar focused on tourism and commerce. A month later, the governor and his Brazilian counterpart in Acre signed the agreement of cooperation formalizing the interchange of geographic data across their shared border.

Sharing Data Across Boundaries

The ability to comprehensively share transboundary data across Amazonian boundaries at the state and local scales is unprecedented and marks a major advance not only for the governments, institutions, and universities involved but also—hopefully—for the indigenous peoples, landscapes, and species in the bioculturally diverse borderlands of Amazonia. Only with improved geographic data and transboundary GIS analysis can policy makers make the best decisions possible to mitigate transboundary threats to the Amazonian rain forest.

About the Authors

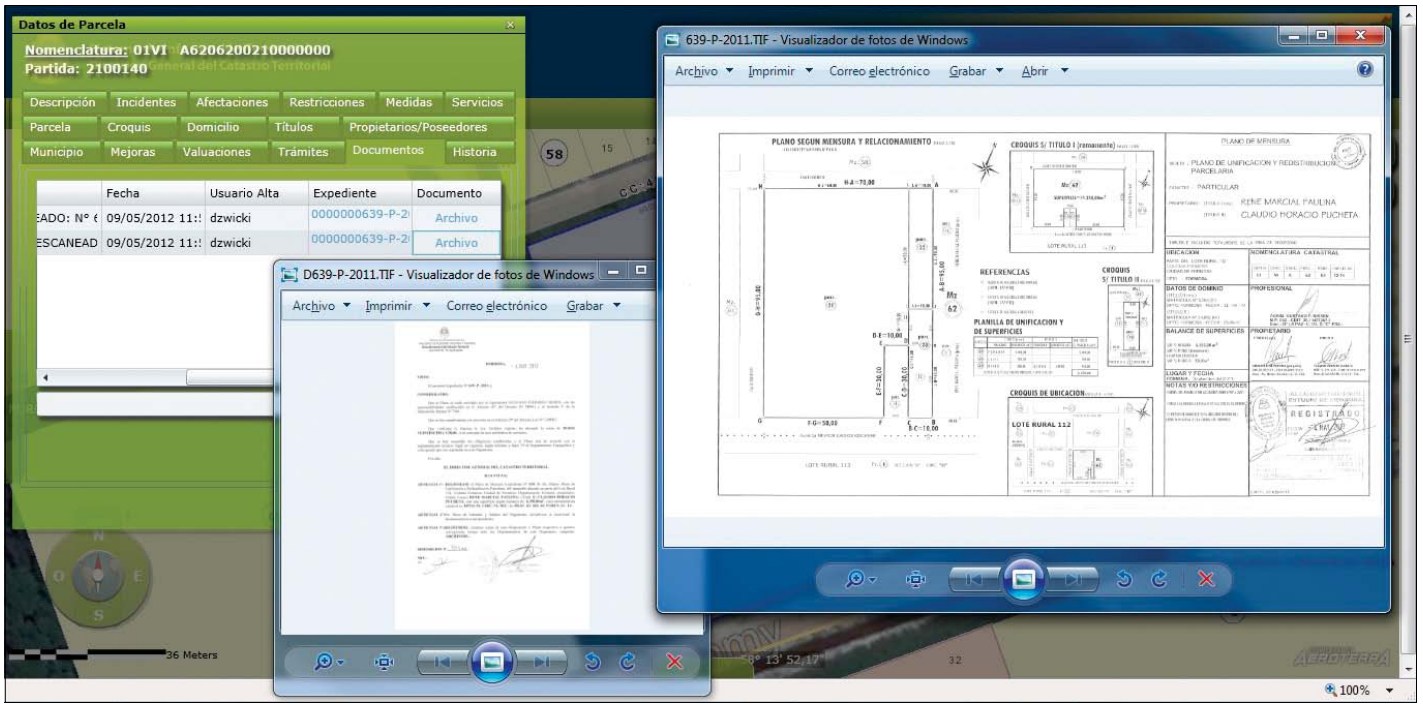
David Salisbury is an assistant professor of geography at the University of Richmond, Virginia; honorary professor at the National University of Ucayali in Peru; and member of the United States National Section of the Pan-American Institute of Geography and History. A. Willian Flores de Melo is an assistant professor in the Center for Natural and Biological Sciences at the Federal University of Acre in Brazil. Jorge Vela Alvarado is professor of agronomy and director of the Amazon Borderlands Research Center at the National University of Ucayali. Bertha Balbín Ordaya is professor emeritus of geography at the National University of San Marcos in Peru and a member of the Peruvian National Section of the Pan-American Institute of Geography and History.

For more information, contact David Salisbury (e-mail: dsalisbu@richmond.edu, tel.: 804-289-8661).

Argentine Land Registry Launches Territorial Information System

Highlights

- ArcGIS connects the local governments in an enterprise system to manage and edit the geodatabase and publish maps.
- The new system allows citizens easy access to the provincial land registry information.
- The GIS-based web cadastral management system handles 160,000 parcel records and supports more than 80 jobs.



The territorial information system's management module links to digital documents, such as these scanned cadastral surveys and the legal document that validates the transaction.

The Dirección General del Catastro Territorial (General Directorate of Cadastre Land [DGCT]) of the Province of Formosa, Argentina, is responsible for managing, maintaining, and updating the geographic information and legal valuation of approximately 160,000 parcels that make up the province, contributing to traffic safety, secure land tenure, land-use planning, and urban financing through property taxes. To continue to fulfill these responsibilities, it was necessary to have reliable, high-quality land information that could be accessed easily and efficiently.

Officials implemented a new GIS to address these needs and realize their vision of having a digital cadastre that is open and allows citizens easy access to the provincial land registry information. This project involved new technological advances within the provincial administration.

Choosing a Partner

Following careful examination of the available options, DGCT (which is integrated with the property registry systems of the Department of Revenue) and the Province of Formosa selected Aeroterra S.A., Esri's distributor in Argentina, to update the territorial information system of DGCT and build a multipurpose, modern, efficient, and web-integrated application linked to other provincial and municipal administrations, allowing graphic and alphanumeric information to be updated and easily accessible to both the public and professionals.

The comprehensive system involves the use of data, geographic databases, technologies, processes, and staff to generate organizational and interorganizational synergy needed to efficiently manage the new challenges facing modern states.

Updating the Territorial Information System

The main activities included in the updating project were the following:

General Design of the Project—The project design began with a thorough description of the components of the architecture, both software and hardware, as well as the features of each application and the system interfaces. The plan included the migration and integration of data, the training of staff, and change management and implementation strategies.

Administrative Reorganization and Redesign of Processes—Project deliverables included a survey report containing the description, processes, and tasks in each area and a procedures manual with an outline of the proposed procedures, along with the proposed reorganization, justification for the proposed changes, the organizational structure, and job descriptions of each area.

Acquisition of GIS Licenses—Aeroterra S.A. and the Province of Formosa determined that ArcGIS software would ideally suit the needs of the DGCT and the municipalities of Clorinda and Formosa. ArcGIS for Desktop and ArcGIS for Server connected these local governments in an enterprise system to efficiently manage and edit the geodatabase and publish maps.

Information System—The system consists of the following components or subsystems:

- A web cadastral management system to support all the functions and operations performed in DGCT, which has more than 160,000 parcel records and more than 80 jobs
- A consultation and management web system to make available to the community (via the Internet) information residing in the territorial database and facilitate the processing of survey plans by professionals who deal with the provincial land registry (Interfaces will be fully integrated through the Department of Revenue, the Real Property Registration, and Cadastre Municipality.)

Data Migration and Integration—Aeroterra S.A. designed a procedure for migrating data from its existing format to the new geodatabase model based on data migration mapping without generating inconsistencies.

Monitoring and Control—Supervision and quality control of products are supported in SharePoint and the communication protocol designed for this project, speeding up decision making.

The New System Goes Online

The updated Territorial Information System of DGCT was named the Land Information System and was inaugurated and became operational December 2, 2011. The event was chaired by the minister of economy, treasury, and finance, Ms. Ines Beatriz Vecchietti Lotto. Also participating were the director of cadastre Ruben Dario Mirando Bobadilla, general director of revenue Sergio Rios, and undersecretary of provincial unit systems and information technology Luke Vincent.

"The development of new tools aims to facilitate citizen access to information and also enable the government to make decisions in a timely manner, providing secure data necessary to carry out optimal management," said the minister, who also mentioned the provincial state investment in computer equipment and software and the involvement and commitment of human resources in achieving success in implementing the new computer system.

For more information, contact Marco Colaluce, solution manager, Aeroterra S.A. (e-mail: mcolaluce@aeroterra.com), or visit **www.aeroterra.com** or **formosa.gob.ar/catastro.html**. DGCT of the Province of Formosa was a recipient of Esri's Special Achievement in GIS (SAG) Award at the 2011 Esri International User Conference.

Bolivian Pipeline Company Expands into Mobile Asset Management

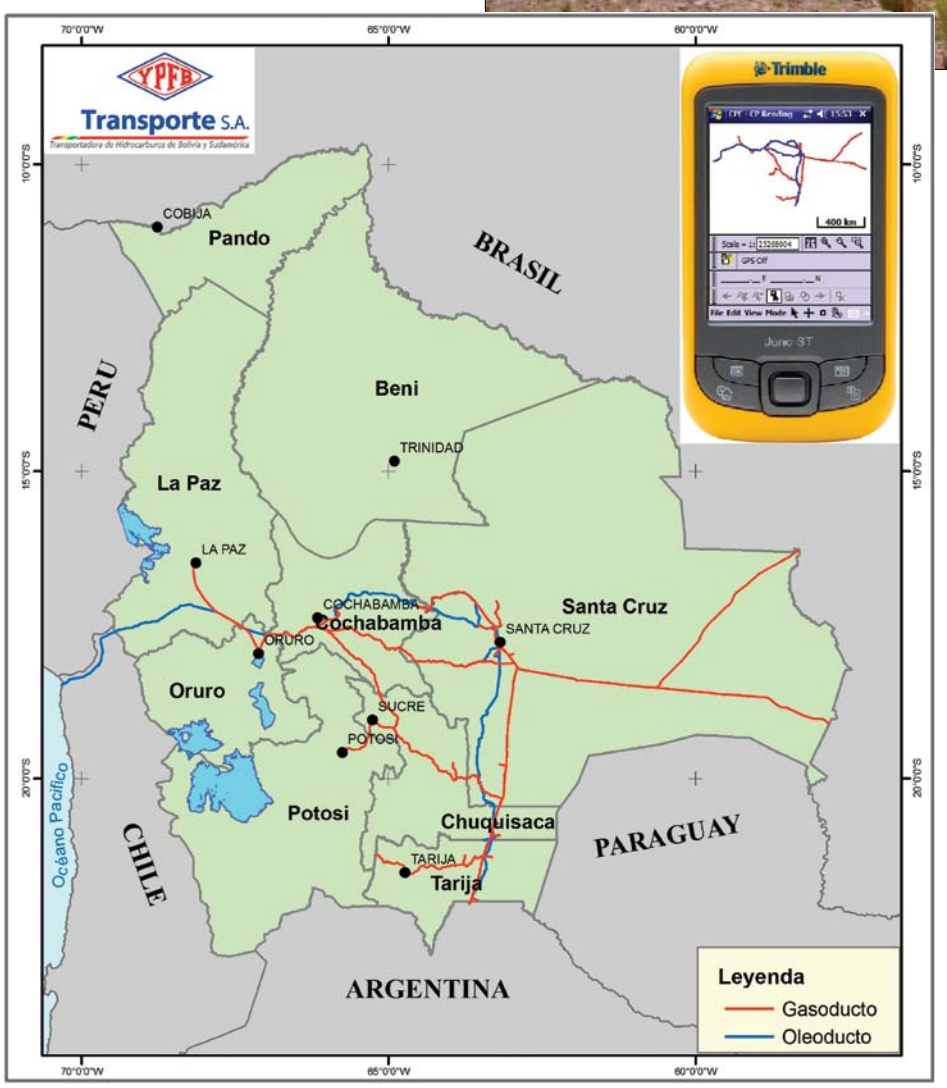
Highlights

- With GIS, the company has better met increasing requirements for data maintenance, mapping and reporting, and integrity management.
- The ArcGIS Pipeline Data Model streamlined analysis specific to gas and liquid pipeline systems.
- Field teams standardized asset inventory using GIS and mobile devices with GPS-enabled data capture.

YPFBT pipelines traverse the beautiful, expansive, mountainous regions of Bolivia.

Landlocked Bolivia is unique among nations for many reasons, not the least of which is its wide range of terrains, climates, and biodiversity, which are in turn a consequence of precipitous altitude changes within the country. From Andean glaciers to Amazonian rain forests, the country is a patchwork of varying elevations, including dozens of active and extinct volcanoes and innumerable rivers.

YPFB Transporte S.A. (YPFBT) is Bolivia's major hydrocarbon transportation company.



YPFBT's mobile devices exchange asset data with its GIS. Finding the right solution involved many entities within the organization.

YPFBT currently operates more than 6,200 kilometers of natural gas and liquid pipelines throughout Bolivia, many of which traverse geologically active terrain that's subject to landslides and earthquakes.

The pipelines range in size from 4 to 36 inches in diameter. Construction of some of the liquid pipelines dates back to 1955, while some of the gas pipelines were constructed as early as 1968, causing YPFBT to face challenges that typically accompany the maintenance and protection of an aging infrastructure in an inhospitable environment that includes dense vegetation, heavy rains and flooding, and mountainous terrain.

Due to the limitations of its legacy CAD drawings, YPFBT made the decision in 2009 to transition to an interactive, GIS-based mapping system. With this, the company was able to better meet the increasing requirements for data maintenance, mapping and reporting, and integrity management.

The company selected Esri's ArcGIS following a thorough research process.

"It used to take several months of drawing updates and corrections to generate a new set of company operation maps with our old CAD-based mapping system," says GIS specialist Giovanni Rojas, who then explains that with the company's new ArcGIS software-based mapping system and other software, now it only takes a couple of days.

YPFBT has continued to expand on its Esri technology foundation. The ArcGIS Pipeline Data Model geodatabase schema has also proved to be an enormous boost to YPFBT's GIS capabilities, since it was designed specifically for storing information specific to gas and liquid pipeline systems.

Before YPFBT moved to its new mapping system and the In-Line Inspection (ILI) tool, anomalies detected were located by a manual chaining method so the defects could be exposed and repaired.

"Locating a defect this way was inaccurate, labor-intensive, and very expensive," says Juan Hurtado, YPFBT's ILI operations manager, "requiring pipeline maintenance crew members to chain the site and usually several verification digs. Now, with GPS and linear referencing, we can accurately locate the underground pipeline features and defects. This means that when the ILI tool reports a defect, a crew member can easily navigate to the site and locate and mark the position for the excavation crew."

Enhancing Field Data Collection

In 2011, YPFBT was looking for ways to build on the success it had achieved with ArcGIS. The company wanted to enhance the level of detail and integrity of its field asset data collection processes and was looking for a mobile solution that could support complex workflows through standardized forms.

"While collecting burial data for the geohazard risk assessment project, we encountered many undocumented reroutes and emergency works performed by maintenance crews," says Graciela Gutierrez, risk assessment operations manager. "This emphasized the need to add accurate field data collection to our GIS-based mapping system and risk assessment in order to ensure precision and reliability."

The detailed requirements list for the mobile solution was extensive and arrived at through a collaborative and iterative process between YPFBT office and field personnel. The solution had to support ArcGIS for Server. It would have to support relational databases using globally unique identifiers for primary and foreign keys, as well as support Oracle Spatial and SQL Server Spatial databases.

YPFBT also wanted the mobile solution to integrate directly with the ArcGIS Pipeline Data Model because it would enable the company to manage the pipeline data in standardized format. In the end, YPFBT chose CartoPac Mobile from Esri Partner CartoPac International of Fort Collins, Colorado. The solution's GPS-enabled data capture process was designed specifically to map, inventory, and manage field assets with very high accuracy. It allowed field teams to use intelligent, configurable workflow forms running on mobile devices to standardize the asset inventory efforts across all the field teams.

YPFBT began implementation of its mobile solution with a pilot program focused on field data collection related to class location and high-consequence areas. Prior to initiating the 2011 pilot program, YPFBT personnel attended an in-depth training program on the solution to build competence in building, modifying, and managing their own workflow solutions.

The objective of the pilot program was to capture field asset data in two districts over the course of three months, evaluating the solution for accuracy, ease of use, and reliability. The results of the pilot program were a success, and in early 2012, full implementation began. The scalable architecture will eventually support a growing number of mobile users from the Maintenance, Cathodic Protection, and Coating Departments.

YPFBT's expansion into mobile technology was methodical and precise. This extensive, inclusionary selection process resulted in an enterprise approach to defining YPFBT's mobile asset management needs, extending and building on top of the company's GIS system.

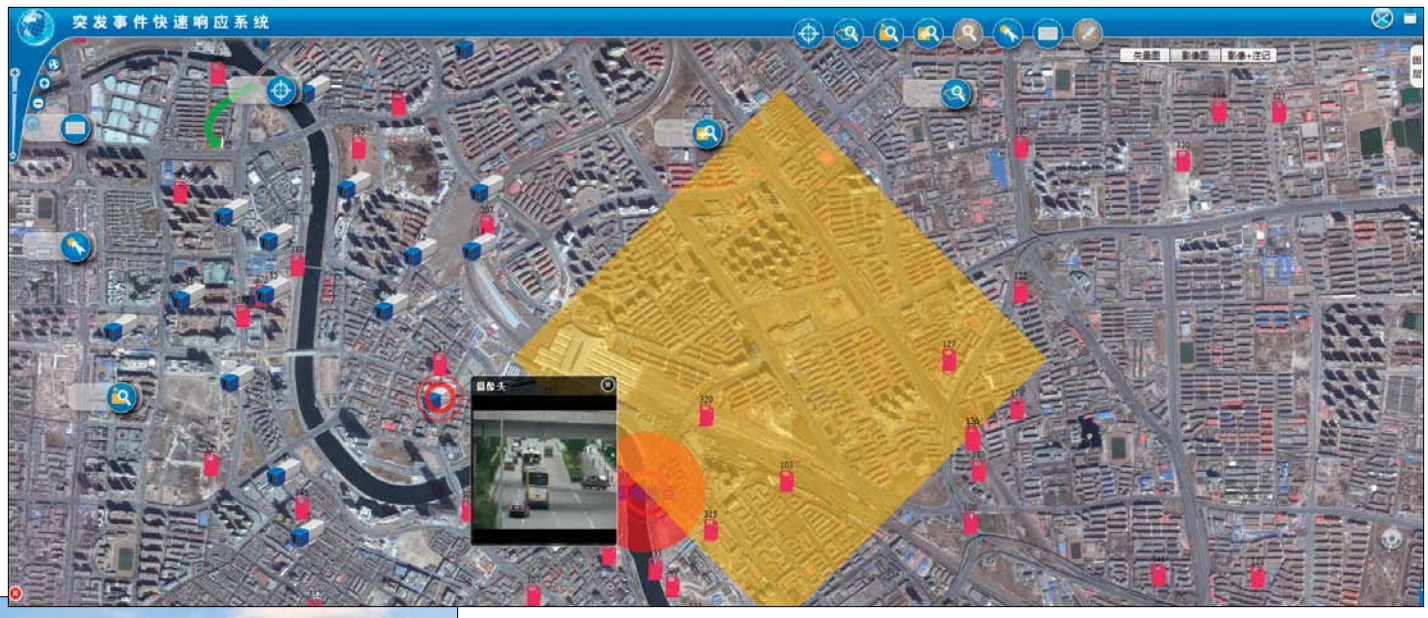
For more information, contact Mario Haderspock España, senior pipeline integrity manager, maintenance management, YPFB Transporte S.A. (tel.: 591-3-356-6772, cell: 721-01587), or Jake Opdahl, Americas sales manager, CartoPac International, Inc. (e-mail: jake.opdahl@cartopac.com, tel.: 970-692-5181).

Nanning City Gets Serious About Emergency Response

The Chinese Metropolis Uses GIS to Enable Coordinated Action

Highlights

- ArcGIS technology serves as the basis of the entire Nanning City Emergency Response System.
- GIS provides automatic tracking and positioning of motor vehicles and important place monitoring.
- The position of help call origins is displayed on the electronic map to ensure that alarm calls are accurately located.



The Nanning City Emergency Response System.

With an overall population of 6.6 million, the modern urban complex of Nanning City has a towering skyline and is located where southern and southwestern China adjoin the Southeast Asia economic circle. It is the largest city in Guangxi Province, and due to its many public parks, it is sometimes called the Green City.

Nanning City, China.

Though a historically significant border city, Nanning is making history now due to the development of its pioneering emergency response system.

The Chinese Urban Emergency System

In greater China, the typical urban emergency system is decentralized. In the event of an emergency, citizens need to subjectively judge which of many government agencies they think will be responsible for assisting in an accident and also decide which emergency phone number from a long list needs to be called, such as 110 for police, 119 for fire, 120 for ambulance, 122 for traffic police, 999 for the Red Cross, and 12345 for the mayor's office. There are also separate numbers for flood control; air defense; water, electricity, gas, and other public utilities emergency relief; and so forth. On the one hand, the decentralized management of these systems leads to the waste of resources and, on the other hand, reduces the reaction speed and efficiency of the emergency system. Sometimes calls are rejected by the agency because citizens judged incorrectly. Even if they've made the right call, an accident may involve various agencies, and the coordination between them might cause a significantly delayed response.

The New Guiding Star

But for Nanning City, that is all in the past. Nanning City Emergency Response System is China's first urban emergency response system constructed under the approval of the State Planning Commission and is China's only system based on government leadership. The system is unified so that no matter what accident citizens report, they can choose any of the telephone numbers they remember, are familiar with, or even just like. All these numbers are transferred to the central Emergency Operations Center, and then the system determines which agencies should respond, significantly streamlining and speeding up emergency response. Through interoperability, all kinds of rescue resources are shared, and a unified command and coordination is achieved between different departments, police districts, and police types.

ArcGIS Involvement

ArcGIS technology serves as the basis of the entire Nanning City Emergency Response System, and it integrates the data from public security, traffic police, fire control, medical, telecommunications, electricity, municipal construction, and other industries. Emergency response, as its name implies, is quick joint action to dispose of a variety of sudden social emergency issues and events. The key is to use the joint response with highest efficiency. ArcGIS is the new foundation of that response.

Currently, the GIS covers 22,080 square kilometers in the municipal districts; has 1:1,000, 1:2,000, 1:5,000, 1:10,000, 1:50,000, 1:100,000, 1:250,000, and 1:500,000 scales; and has 56 data layers (more than any other electronic map system in China) concerning distribution of various police types, administration areas, fire control facilities, medical institutions, water conservancy facilities, alarm phone positioning, electrical equipment, governmental agencies, and other enterprises and institutions. The system can display the data and images of GPS and monitoring points in real time.

In addition, three fields of information for nearly one million phones in Nanning can be shown on the electronic map; for all alarm calls from fixed-line telephones, electronic maps can display the location of the callers and telephone owner information.

Says Jingtao Zhang, director of emergency industry sales for Esri China Information Technology Co. Ltd., Esri's distributor in China, "Even if the help seekers are not able to express themselves well, such as the disabled, critically ill patients, and children, GIS can accurately display the position of help calls on the electronic map so as to ensure that all requests for assistance, complaints, and alarm calls are accurately located."

Moreover, application of ArcGIS equips Nanning City Emergency Response System with automatic tracking and positioning of motor vehicles (including special vehicles), important place monitoring, public facilities information (remote control, telemetry, video monitoring and regulation, remote viewing), and other value-added application scalability.

Full Coverage of Administrative Areas

Inspired by a Nanning City leaders' visit to United States 911 emergency centers in 1998, this system began operation in 2002. Today, tremendous results and changes are clearly reflected in the following figures: it now takes just 2 seconds to deal with emergency situations, much faster than the domestic industry standard of 10–15 seconds; emergency handling capacity is six times greater than before the establishment of the center; alarm calls received daily have increased by six to nine times, from about 800 to more than 5,000 calls on average; the effective help-seeking rate increased by 1.7 times; and the command signal coverage area expanded by 120 times. Data shows that, up to May 2011, the system had accumulatively answered more than 15.28 million help calls, an average of more than 150,000 monthly, and had dealt with more than 2 million valid events of all kinds. This is the great role played by Nanning City Emergency Response System.

An upgrade of Nanning City Emergency Response System, including ArcGIS, is about to be performed, which, when completed, will gradually shift its analog trunking mode to a more stable and reliable digital trunking. Nanning invested in the construction of one switching center and eight coverage base stations for the large district system. The new system will achieve full coverage of the administrative areas of Nanning City and interconnection with the Guangxi government.

For more information, contact Biao Wen, officer of Nanning City Emergency Response Center (e-mail: wbok88@163.com), or Jingtao Zhang, director of emergency industry sales, Esri China Information Technology Co. Ltd. (e-mail: zhangjt@esrichina.com.cn).

Town Sharpens Proactive Sewer System Management

By Alan Saine, Civil Engineer, Town of Mooresville, North Carolina

Highlights

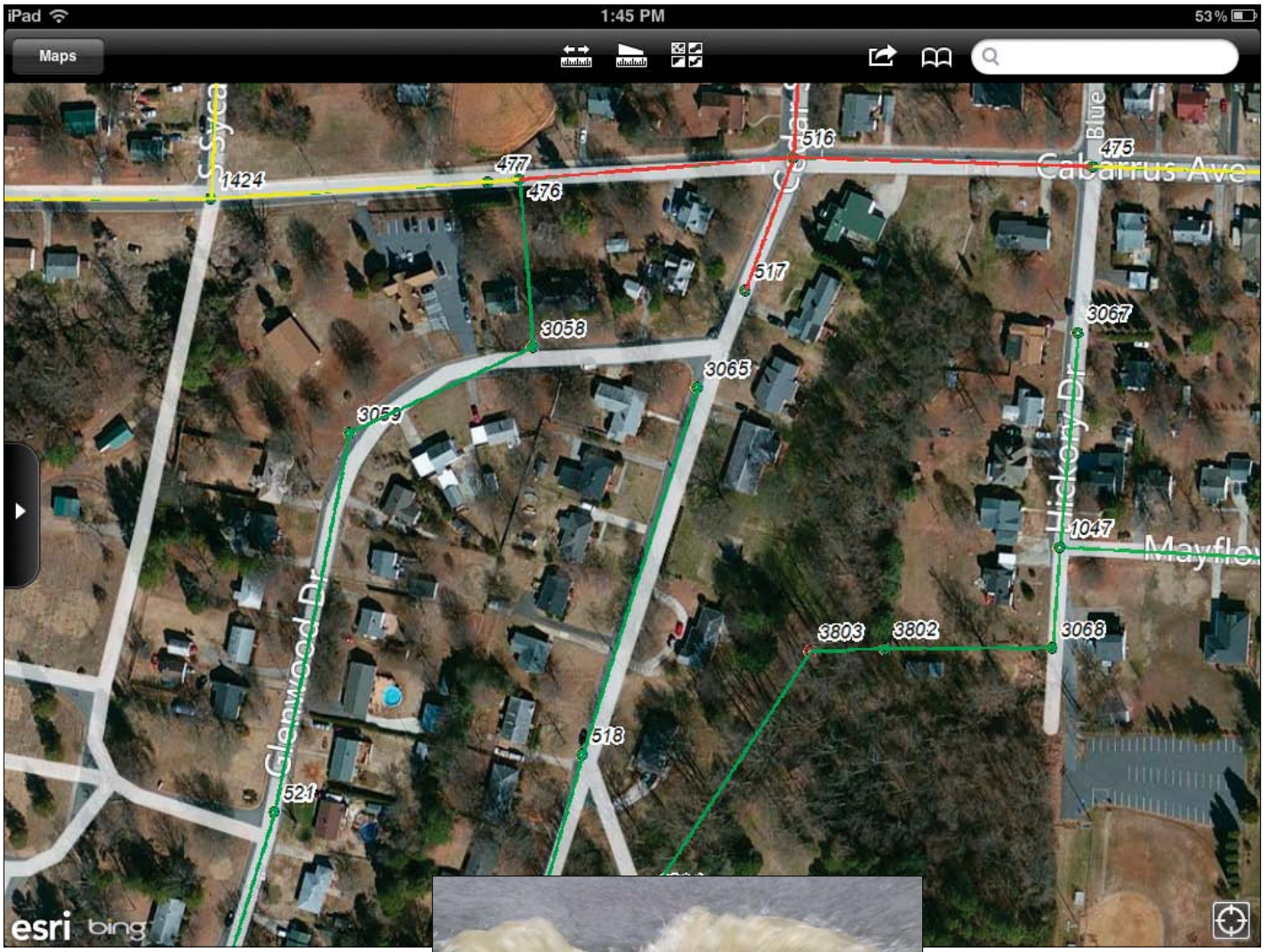
- GIS has helped staff identify and remedy problem spots—a process that used to take weeks but now takes minutes.
- GIS was used to calculate the number of sewer mains that were cleaned that month and their lengths.
- Through Python automation, it was easy to use ArcGIS to display all the cleaning data.

In 2010, the Town of Mooresville, North Carolina, began experiencing a rise in the number of sanitary overflows and sewer stoppages. The reason for the problem was evident: the Town of Mooresville has more than 6,000 manholes and 250 miles of sanitary sewer gravity-main lines, and only 30 percent of that infrastructure has been constructed in the last 20 years. In addition to aging infrastructure, the Town of Mooresville population has tripled in the last 20 years, thus putting more strain on the significantly aged sanitary sewer system.

Mooresville, like most municipalities, has permit requirements—in this case regulated by the Division of Water Quality, a division of the North Carolina Department of Environment and Natural Resources. One of the requirements is that the permittee shall assess all cleaning needs and develop and implement a program appropriately cleaning all sewer lines. The Mooresville Water/Sewer Maintenance Department (WSMD) manages this requirement on a day-to-day basis and recently requested the assistance of the Engineering Department to help determine all the distressed spots, or hot spots, to more strategically and effectively clean and maintain the system.

"Economic growth kept our staff very busy for years with installing all the water and sewer taps," says Jamie Johnson, water/sewer maintenance field supervisor. "Since the growth slowed due to the recession, we had to move from a reactive approach to being proactive. In the past, crews would alternate cleaning sewer lines in whatever area they wanted to, and areas were being left out. By restructuring crews, we dedicated a crew to do all the line cleaning, and with this continuity, we were able to grasp the needs of our wastewater collection system."

To assist WSMD in identifying distressed spots on the system, the Engineering Department needed to pinpoint these locations on a map and assign dates for when the sewer features (manholes, sewer main) were cleaned. WSMD maintained monthly data, from August 2009 to January 2011, in Microsoft Excel spreadsheets of where and when the sewer cleaning occurred. Each spreadsheet contained the cleaning data for that month, as well as a unique identifier, Manhole ID (MHID), to capture the location. Fortunately, the Engineering Department had recently finished a yearlong project, which employed ArcGIS software, to locate, map, and input all the features of the town's sanitary sewer system. Once the spreadsheets were reviewed, Python scripting was chosen as an optimal way to process the batch of Excel format cleaning data and generate a comprehensive dataset.



Above: The Esri application on the iOS device displays the sewer cleaning data and the Manhole IDs (MHIDs); therefore, the user knows if that line has been cleaned recently. **Left:** A sewer overflow.

Automating with Python

Creating the cleaning data would require the repetition of several steps; this process was simplified using Python. The Python script was developed so that users would have the Excel file in a folder on a computer, and they can extract the month and MHIDs from it and perform several analyses. The Python script was made accessible to any user via ArcGIS.

The first step was to create the cleaning data. ArcGIS was used to calculate the number of sewer mains that were cleaned that month and their lengths. The frequency of how often a line had been cleaned was calculated and coded using a red/yellow/green scheme. Hot spots, or areas that had been cleaned seven or more times, were displayed as red so it would be evident where there were issues.

Locating the Cleaning Hot Spots

The ability to map where the sewer cleaning was occurring and how often it occurred yielded some interesting results. There were over a dozen separate areas where the sewer mains had been cleaned 7 to 12 times in an 18-month span. This information became a catalyst for improved interdepartmental communication between WSMD and the Town of Mooresville Fat Oils Grease (FOG) Department.

Says Jamie Levis, FOG compliance officer, "Our sewer cleaning map has helped us identify those areas that require more frequent inspections and increased pumping/cleaning frequencies for food service establishments. The use of GIS has helped the FOG staff identify and remedy problem grease interceptors [problem spots] on multiple occasions. With the use of this tool, what used to take weeks now takes minutes to look up and identify."

Fixing the Hot Spots

Mapping the hot spots gave WSMD and the FOG Department specific areas to target and improve. Several methods were used to investigate these areas, such as reviewing closed-circuit television of the sewer mains and inspecting all the oil/water separators in the vicinity of the sewer cleaning hot spot. Several problems were fixed by using simple root control treatments and locating grease violations by local restaurants.

Prior to this project being implemented, in 2010, WSMD did not know where the hot spots were and did not have a way to track areas that were being repeatedly cleaned. In 2010, the town cleaned 51 miles of sewer mains. Of those cleaned sewer mains, 58 percent had already been cleaned earlier that year. In 2011, after the project, the town cleaned 144 miles of sewer mains, and only 32 percent were repeats. By having the ability to identify hot spots and correct issues, the town was able to clean almost three times as many areas and cut the repeat trips by 26 percent.

"Since our productivity has increased, we have noticed a decrease in main line stoppages and after-hours callbacks, resulting in cost reductions, including less overtime pay for employees," says Johnson.

Ryan Rase, deputy town manager, also praises the results of the project: "The WSMD has not been immune to the downturn in the economy, and we are constantly being asked to do more with less. Through the use of technology and teamwork, we were able to provide a tangible example of how WSMD has been able to become more efficient."

Going Mobile

Today, the town continues to map the sewer cleaning. Using Esri's ArcGIS, workers can now use iPads to log cleaning data directly into the system from the field (instead of keeping track of Excel spreadsheets). The sewer cleaning crew can instantly view where the cleaning truck has been in the past two years and be strategic in cleaning by maximizing the route of the cleaning crew and migrating to areas that need attention. Additionally, it can easily identify hot spots that show up red on the map and communicate where customer intervention may be needed. This project created a proactive approach to maintaining the town sewer system and enhanced interdepartmental communication.

About the Author

Alan Saine is a civil engineer and engineering intern at the Town of Mooresville in North Carolina. He is a graduate of the University of North Carolina, Charlotte, and is currently pursuing his master's degree in geospatial information science and technology at North Carolina State University. At Mooresville, he recently finished implementing an enterprise GIS system in the Public Services Division. He is a member of URISA, is currently working toward his GISP, and plans to sit for the Professional Engineering Exam in 2013.

For more information, contact Alan Saine, civil engineer for the Town of Mooresville, at tsaine@ci.mooresville.nc.us.

Three-Dimensional Spatial Analytics and Modeling Is Now SOP for the City of Forth Worth, Texas

By Havan Surat, GISP, Comprehensive Planning Section, Planning and Development Department, City of Fort Worth

Highlights

- The City of Fort Worth depends on ArcGIS for presenting difficult information to the public in a very easy format.
- ArcGIS 3D Analyst for Desktop helps produce three-dimensional city zoning maps.
- Three-dimensional transparency maps are useful for estimating comparisons between current and allowable building heights.

Fort Worth is the second-largest city in the Dallas-Fort Worth metro area in the United States of America. Located in the state of Texas, Fort Worth's population is comparable to other cities in the state, such as Austin, Houston, and Dallas. Since 2000, Fort Worth has been the fastest-growing city with a population of more than 500,000 people in the nation. According to the US Census Bureau, its population increased by more than 200,000 people during the last decade.

Fort Worth has a rich history of planning. The Planning and Development Department received credits for innovative planning area studies from the national American Planning Association. The department consists of two divisions: Planning and Development. The Planning division is further divided into sections based on current and long-range planning activities in the city. The Urban Design team in the comprehensive planning section primarily focuses on the urban design-related activities in the planning areas along with the production of graphic illustration and three-dimensional visual studies.

The city has created 16 urban villages and a few urban design districts within the city of Fort Worth. The city anticipates mixed-use development patterns and walkable environments in these areas with emphasis on pedestrian-oriented approaches and buildings related to human scale. To make the city's efforts understandable to the public and developers, the Urban Design team has been asked to produce three-dimensional building models that resemble the desired developmental patterns in the prominent areas of the city.

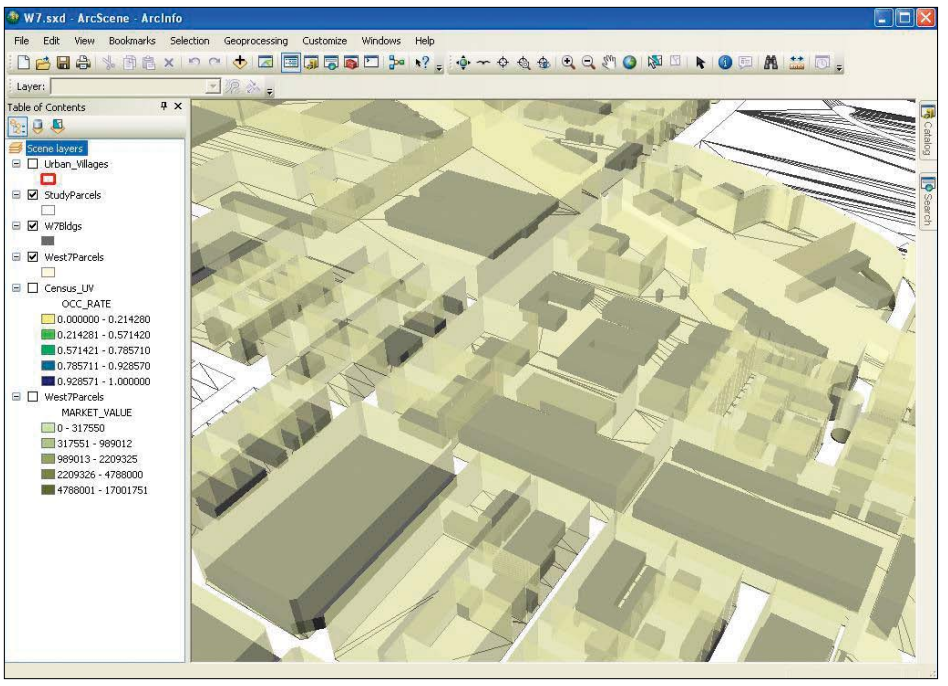
Another request for the development of 3D models came from the zoning section team, which was finding it difficult to explain the city zoning codes to the public. It felt that the development of building 3D models that explain the codes and regulations could assist the public to interpret the content of the zoning codes. As the mixed-use zoning codes in the city have been revised recently, the city is looking to prepare a new brochure for the mixed-use zoning district that consists of 3D graphics to illustrate the content of the codes.

The city has ArcGIS users in all departments using GIS for multiple mapping tasks. The Urban Design team has found, in particular, that ArcGIS 3D Analyst for Desktop is the perfect tool for creating both 3D building models and performing three-dimensional analysis with one or more feature datasets.

Three-Dimensional Analytic Maps

In addition to building 3D models, 3D tools have been utilized to produce a variety of three-dimensional analytic maps. One analysis represents the gradual variation of the population density in the vertical direction, with the assistance of 3D tools, for better illustration purposes in planning documents. Another study produces the three-dimensional zoning maps that replace the traditional zoning maps. Traditional city zoning maps are usually represented with specific colors depicting appropriate use allowed in the zoning districts. When existing building models have been shaded with the city zoning color symbology, the final 3D maps would add building height information to the zoning content. The Urban Design team has seen the potential of presenting the 3D information to reveal the existing development patterns, in addition to the future development proposals, to the developers, consultants, and the public.

The three-dimensional transparency study is another product generated with the aid of 3D tools. This study is useful, as it provides a medium to interpret the current development patterns with the future possibilities in the downtown area. The City of Fort Worth supports mixed-use codes and regulations in the denser areas where the developer can build to a higher number of building stories by following mixed-use codes when compared to proposing a single use in a building. If the building has a mix of uses within it, then the building can be taller than the single-use building. The idea of strengthening mixed-use buildings is depicted in the three-dimensional transparency map.



A three-dimensional transparency study in the downtown area shows the difference between existing and allowable building heights in the City of Fort Worth, Texas.

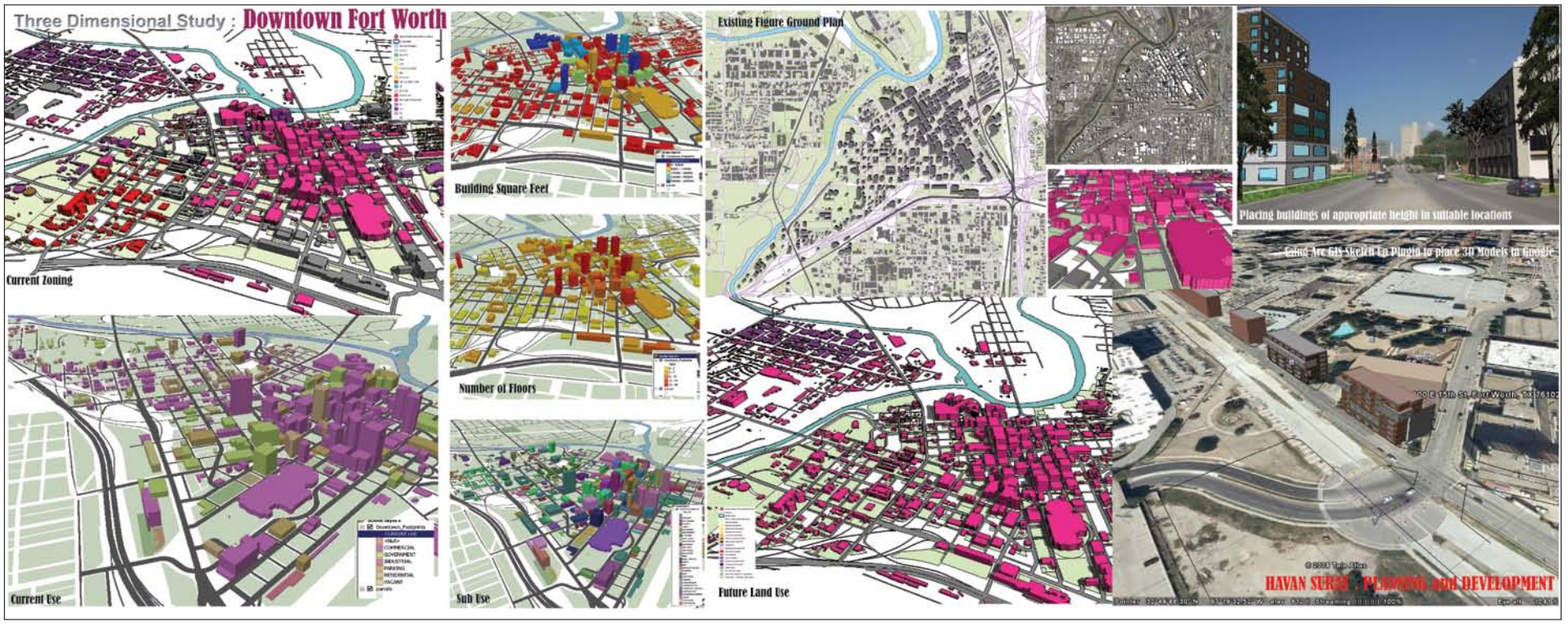
First, the outer parcel is extruded to the maximum building height allowed in the mixed-use zoning code, and then the existing building footprint is pushed to the actual existing building height. The parcel 3D model is set to transparency so that the inside building model is visible. This study reveals to the viewer the difference in heights between the building and parcel models and hints that the building can still rise taller by following the city zoning codes and regulations.

Generally, spatial analytic patterns are displayed two-dimensionally, but if presented in a three-dimensional format, the analysis could be more readable for the public. The city incorporated these maps in zoning code brochures and planning documents. The City of Fort Worth depends on ArcGIS for presenting difficult information to the public in a very easy format with the assistance of ArcGIS extensions.

About the Author

Havan Surat is a planner on the Urban Design team in the comprehensive planning section in the Planning and Development Department with the City of Fort Worth. He holds dual master's degrees in urban planning and urban design from the University of Texas, Arlington, and University of Texas, Austin, respectively.

For more information, contact Havan Surat, GISP, City of Fort Worth (e-mail: havan.surat@fortworthtexas.gov).

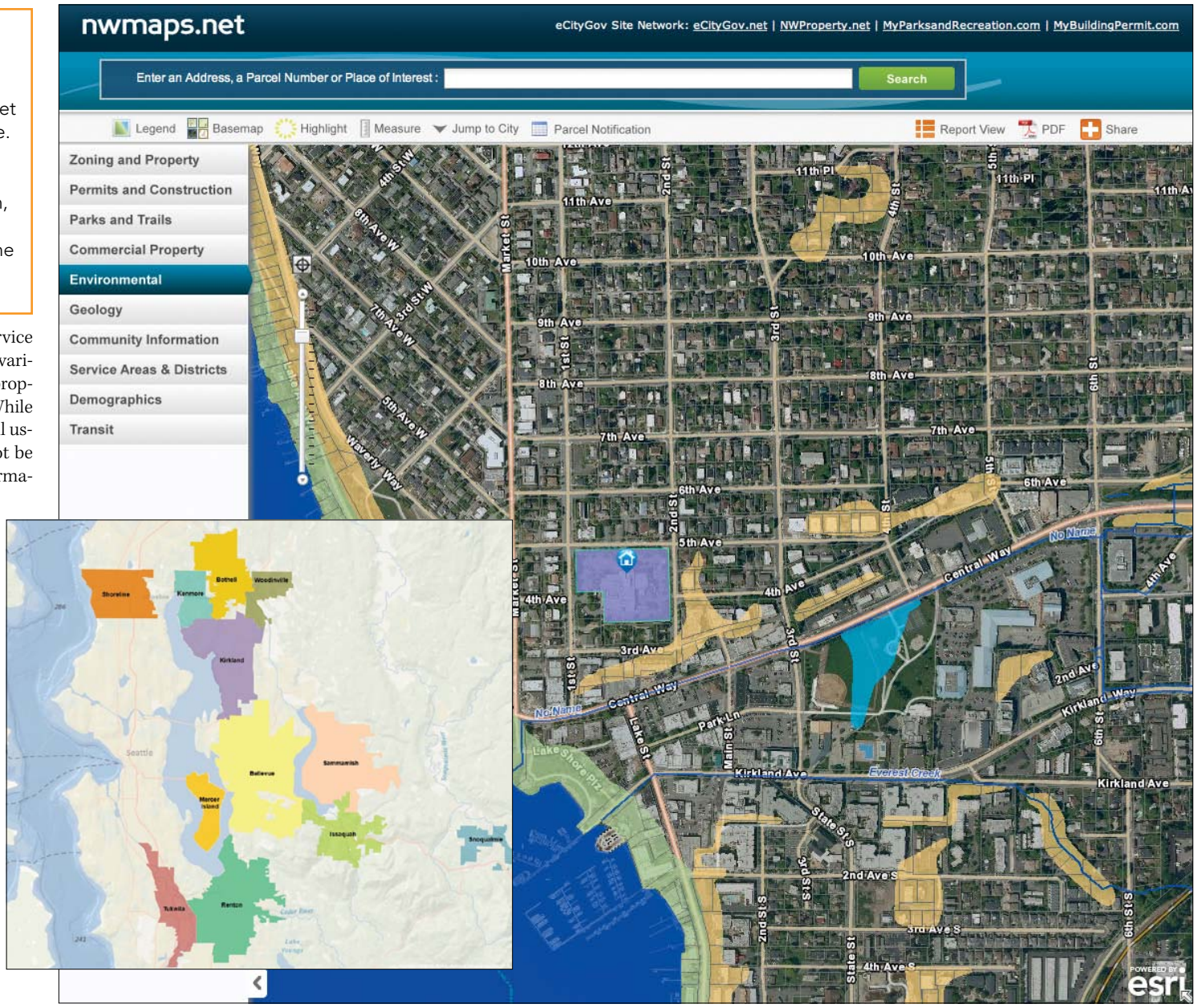


The building models in the downtown area have been studies in terms of current zoning, future and current land use, building square feet, and number of floors.

Puget Sound Alliance of Cities Streamlines Access to Location-Based Community Information

Highlights

- Alliance of cities uses ArcGIS to serve community information to 1.5 million constituents in the Puget Sound region of Washington State.
- New data is processed automatically and includes validation, verification, notification, archiving, and updating.
- ArcGIS automation tools streamline data maintenance and reduce ongoing service costs.



Inset: The NWMaps Service Area in the central Puget Sound region of Washington State. **Above:** Powerful tools available in the ArcGIS platform make it easy for cooperating cities to federate their data.

Citizens today expect a high level of self-service access to community information across a variety of topics. Much of this information is property based and certainly location based. While most of the information is mappable, not all users have strong map literacy—they may not be image- or map-oriented consumers of information. Constituents are often frustrated when they don't know what government agency to turn to for a particular service.

The geography of Washington's Puget Sound region is a dramatic mix of mountains, bays, lakes, and islands. The area is generally known for its verdant green landscapes; fresh seafood; thriving music scene; and, of course, Seattle. In fact, mention Puget Sound to just about anyone, and Seattle is likely to spring to mind. But—just like the dichotomy of mountains and water in the area—bustling Seattle is surrounded by many other cities that have an identity all their own.

Nine of these cities—Bellevue, Bothell, Issaquah, Kenmore, Kirkland, Mercer Island, Sammamish, Snoqualmie, and Woodinville—came together in 2001 to form an interlocal agency called the eCityGov Alliance. The Alliance was created to think, grow, and experiment with business solutions that would replace city-centric web services with seamless, cross-boundary web services.

The Alliance and member cities' goal is to provide constituents with easy-to-find, consistent, web-based services, regardless of the city responsible for providing the service. Since its inception, the Alliance has added 28 cities and agencies as member subscribers to a total of seven Alliance-service-specific web services. The total number of participating municipalities and agencies represents a population of 1.3 million citizens and businesses across a four-county region.

Due to the project's sheer size, both in terms of the number of residents served and the geographic space they were spread across, it quickly became apparent that the Alliance would need to take advantage of technological developments to meet residents' levels of expectation with respect to functionality and the user interface. The goal was to provide constituents with easy-to-find, consistent services, regardless of the city that was responsible for providing the service.

As such, NWMaps.net, one of the aforementioned services, was born. The site, launched the same year that the Alliance was formed, aimed to ease the frustration of residents in 12 Alliance cities—those listed above plus the more recently aligned Renton, Shoreline, and Tukwila. By using this portal, a resident could now access seamless, cross-boundary web services that would provide constituents with easy-to-find answers to their queries, such as which government agency to turn to for a particular service.

Over the years, the eCityGov Alliance has worked to continuously improve its services and portals, making its sites friendlier to users and more efficient. NWMaps.net is no exception. In 2010 and 2011, both the back-office data services and the public-facing user interface of the site were completely rebuilt. The new NWMaps solution architecture is based on ArcGIS for Server.

Bringing a Diversity of Sources into a Common Platform

The eCityGov Alliance and its members are longtime users of ArcGIS. For the revamp, Seattle-based Spatial Development International (SpatialDev), an Esri Partner, was selected to provide a modern solution that was "future proof." The firm was tasked with creating a site that would be both easily extensible to accommodate new information themes and also sustainable with the direction of Esri products.

All totaled, the site's member cities collectively spent more than 6,000 hours making the new site happen—work that involved requirements gathering, database design, data preparation, and oversight of the development efforts.

Although they work together on joint projects through the eCityGov Alliance, each city still manages enterprise GIS programs to support individual work programs. This means that each city builds and organizes data differently in response to organizational structure, IT portfolio, and enterprise priorities. To achieve an orderly federation, the revamp project's technical committee designed a standard data model with which to normalize data into a single repository on top of which new map services are built.

With the new design comes a streamlined process to update data for a single city or for a single data layer within a city. New data is simply loaded as a geodatabase to a central server, where an automated process takes up the task of updating. The process includes validation; verification; notification; archiving; updating; and, finally, a refresh of the map services.

Bringing Together Users and the Information They Seek

When user stories were obtained to help revamp the site, it became apparent that users wanted efficient access to information and not necessarily a map. These user needs and expectations required that some functionality be built around the map to extend the experience for the user.

For example, the project team knew that many NWMaps.net users employ one of three things for finding information: an address, a place-name, or—if they are researching specific properties—a parcel number. To accommodate these three modes in a world where search engines have simplified a search to a single box, the site now provides a single search box that can work with any of those three types of information. In addition, users were provided with both a type-ahead suggest feature and a search disambiguation function that enables fuzzy searches and contextual results.

Another newly introduced element of the home page is a quick search feature that allows the user to focus a search based on a variety of themes, such as permitting, parks and recreation, or construction projects. This functionality involved the integration of tabular and spatial data from member city departments, other Alliance applications, agencies outside the Alliance members, and commercial sources. Once a theme has been selected, the site provides a set of contextual results that promotes relevant topics and presets a map display with corresponding layers.

A Refreshed Site Delivers Results

The new site launched during early summer 2011 in parallel with the legacy site and has been well received by eCityGov constituents. In fact, within 60 days, site traffic had increased by more than 400 percent relative to the month prior to the parallel launch.

For more information, contact John Backman, executive director, eCityGov Alliance (e-mail: jbackman@ecitygov.net). Learn more about SpatialDev at www.spatialdev.com.

Two World-Class Cities in Different Hemispheres

Abu Dhabi, Auckland to Host Upcoming Regional User Conferences

The Esri Asia Pacific User Conference (APUC) (November 5–7) in Auckland, New Zealand, and the Esri Middle East and Africa User Conference (MEAUC) (December 10–12) in Abu Dhabi, United Arab Emirates, are expected to draw thousands of GIS users and distributors from their home regions and worldwide.

Each will offer three days of networking, education, and skill building, as well as preconference workshops and EXPOs showcasing the latest in ArcGIS and geospatial solutions from regional and global companies, according to Jack Dangermond, Esri's founder and president.

"The regional UCs are truly invaluable resources, and I encourage all users to consider attending—especially those who were unable to attend the Esri International User Conference this year," Dangermond says.

The Auckland skyline (photo courtesy of SKYCITY).

The Abu Dhabi skyline (photo by Fotolia).

Esri Down Under in November

This year's APUC will be hosted by Eagle Technology Group, Ltd., Esri's official distributor for New Zealand, at the SKYCITY Auckland Convention Centre.

This is the first time New Zealand has hosted the Esri APUC, according to Gary Langford, CEO of Eagle Technology Group, who terms New Zealand a leader in the adoption and application of GIS technology, as well as a stunningly beautiful setting for the conference.

"The Asia-Pacific is the fastest growing economic region in the world, with its own unique character and challenges," says Langford. "Esri APUC is a must-attend event for GIS professionals to learn of the power of the latest release from Esri, ArcGIS 10.1. I believe that this new technology will empower attendees to positively impact their own communities, both environmentally and economically."

Eagle marketing and communications manager Sarah MacDonald explains that the region has seen an increase in natural disasters, such as tsunamis, earthquakes, and floods, along with the destruction of habitats in many communities. Parts of the region are also very highly populated.

"Key themes in the conference will be how spatial technology is being used to manage disasters and to redesign sustainable and more livable cities," MacDonald says.

Incorporating the 16th Annual New Zealand Esri User Group Conference, "Esri APUC is expected to be the largest gathering of GIS professionals and Partners ever to be held in this part of the world," MacDonald says.

The New Zealand Esri User Group is an independent group with a membership representing more than 300 organizations. "It's a strong and active community whose participation in this conference is highly valued for their input into the content that speaks directly to the needs of the community," she says.

Full Agenda Planned—The APUC, says MacDonald, is focused on enabling Esri users to get the most from their experience. Preconference workshops, one-on-one technical sessions, and training advice will complement numerous networking and social events.

Jack Dangermond also will be on hand to deliver his vision for Esri and GIS at the Plenary Session.

Social Media Gaining Ground—While the Asia-Pacific region has a broad geographic reach and some language barriers, Eagle foresees a future

More Exciting Than Ever, GIS Day Is Nearly Here

Celebrated around the world, GIS Day is an annual salute to geospatial technology and its power to transform and improve our lives. It provides an international forum for users of GIS to demonstrate real-world applications that are making a difference in our society.

Less than a month from now, on Wednesday, November 14, thousands of users in more than 60 countries are expected to participate in about 600 events—either as hosts, attendees, supporters, or volunteers—demonstrating why GIS is so important to the world.

A new and improved GIS Day website (**gisday.com**) is packed with features that will get you excited about GIS Day 2012 and make the tasks of finding, developing, and hosting events more fun than ever. The new features include the following:

- An interactive map showing GIS Day events around the globe. Register your event to promote it on the map. If you are interested in attending or volunteering at an event, you can easily find a GIS Day event near you.
- A resources page provides hosts with the items they need to promote events, including the GIS Day logo, customizable marketing files, and a PowerPoint template, as well as interactive map games, videos, and e-books.
- Our new, streamlined registration offers event hosts a quick and simple registration experience. Plus, all registered events will receive complimentary GIS Day giveaways, resources support, and a place on the Events Map.
- A downloadable video is available for hosts to use to demonstrate the many uses of GIS to a non-GIS audience.
- A Flickr photostream of successful past events submitted by hosts around the world can be viewed.

Students enjoy a challenging geography exercise as they explore a large floor map of the world on November 17, 2010, at the Killeen, Texas, Civic and Conference Center.

City of Killeen, Texas

"The new GIS Day website seems more intuitive and responsive and has a modern, easy-to-look-at appearance," observes Colen Wilson, GIS manager for the City of Killeen, Texas. "The content feels like it contains more in less space. It's arranged to provide a consolidated approach with commonsense access and a slick look and feel."

Wilson should know. Killeen has been hosting GIS Day events since 2006. The city's celebrations have grown into what he believes is "the largest single-day student-attended GIS Day event in the world" (based on attendance records of registered GIS Day events provided by Esri staff).

Students enjoyed a challenging geography exercise as they explored a large floor map of the world on November 17, 2010, at the Killeen, Texas, Civic and Conference Center.

Killeen's GIS Day 2012 will be big again, projecting 1,350 student attendees, 30 booths, and the Big Canyon Balloon Show from Trinity Science Solutions.

Wilson observes that the redesigned GIS Day website has really facilitated planning.

"The registration section provided a simple process and was a breeze to get through," he says. "The resources links are extremely valuable and available in one location."

Montserrat

The little Caribbean island nation of Montserrat hosted GIS Day events every year from 2006 to 2010.

"We missed last year for financial reasons," acknowledges Lavern Ryan, GIS manager for the Montserrat government. "But this year, we are hoping to put it on again because we've just launched our online mapping facility called Montserrat Land Info [**landinfo.gov.ms**]. Our GIS Day this year will promote that website."

As in the past, Ryan and her staff plan to interact with the general public, children, and users—this time employing the GIS Day event as a stepping stone that will lead to the government providing information in the cloud.

First, there will be a morning open house held within the government planning offices for people invited from various government departments; utility companies; and real estate, architecture, and other commercial groups.

Then Ryan and Rondell Meade, a GIS technician, will go into the schools to conduct GIS sessions with students. As before, they plan to work mainly with children from grade six who are leaving primary and entering secondary school, as well as those leaving secondary school to go into higher education.

Ryan expects a turnout similar to that in 2010, when GIS Day was well attended and a big success. Whether the audience is adults or children, she terms GIS Day useful "across the board because we can talk about what GIS can do and how it can benefit each person who uses it."

increasingly better connected through social media—by understanding and identifying common problems, and by a mutual desire to make a difference through understanding our world.

MacDonald notes, "At Esri APUC, we will be hosting an ArcGIS Online competition to be judged by peers. This is an opportunity for everyone from the region to learn about the latest technology from Esri and to display their work and tell their story."

APUC attendees should especially enjoy the SKYCITY Auckland Convention Centre, a massive, centrally located business and entertainment complex, which many visitors consider a destination in its own right. SKYCITY is home to more than 20 quality restaurants, bars, and cafés; two first-class hotels; a world-class casino; and Auckland's iconic landmark, the Sky Tower.

For more information on APUC, visit **esri.com/apuc**.

Major December Conference in Abu Dhabi
Make plans to connect and collaborate with ArcGIS users December 10–12 at the 2012 Esri MEAUC in Abu Dhabi, United Arab Emirates.

"Esri is fully engaged in organizing the MEAUC with full sponsorship and coordination from the Abu Dhabi government," says Hossam Sayed, senior solutions engineer, based in Esri's Dubai office.

According to Sayed, the event is expected to attract more than 1,000 geospatial technology users to the Abu Dhabi National Exhibition Centre for two days of preconference seminars, three days of technical workshops, industry track presentations, networking, and a GIS Solutions EXPO for showcasing new products and solving vexing problems.

"This event is for all users, students, distributors, and Partners—anybody who is interested in doing business in the Middle East and Africa," he says. The conference will allow attendees to hone a fine competitive edge with a close—possibly first—look at ArcGIS 10.1 capabilities, and how to extend their GIS through cloud and mobile applications.

They'll learn about best practices in their region at user presentation sessions and how to increase return on their software investments by gaining new skills at technical workshops, the Learning Lab, and interactive software islands. What's more, a Map Gallery and special exhibits will demonstrate ArcGIS in action, while Lightning Talks will facilitate getting many new ideas in a short time.

Esri founder and president Jack Dangermond will greet and inspire attendees at the Plenary Session on Monday, December 10, along with Esri corporate technical evangelist John Calkins. Also on hand will be several Esri staff specialists from Esri headquarters in Redlands, California, in addition to Esri staff from the Dubai regional office.

Not only will users learn firsthand about the latest advances in Esri technology and strengthen their GIS knowledge and skills, but they will also connect with Esri Partners, product engineers, and GIS professionals—both regional and global—and explore GIS topics in a variety of specialty tracks, as well as learn how to maximize their current GIS investments.

All Esri technology users from the Middle East and Africa are encouraged to attend.

For more information on the MEAUC or to register, visit **esri.com/events/meauc**.

Canada
Thousands of miles north of the island of Montserrat, Canadians likewise have a passion for GIS Day.

"GIS Day gives us the opportunity to show our clients the numerous successful applications of GIS within our municipality," says Marianne Murphy, manager-GISS, Halifax Regional Municipality. "It allows us to engage them in our products and services and demonstrate what GIS can do for them."

At the University of Ottawa, Dr. Barry Wellar, professor emeritus of geography and environmental studies, terms GIS Day "a major event. It provides a fun and interactive setting for our students and the community to learn about GIS and facilitates insightful discussions about the role of GIS in our lives."

Missouri Geographic Alliance
The Missouri Geographic Alliance, led by coordinator Shannon White, plans GIS awareness events throughout the year to bring attention to geospatial technologies.

This year, it wants more professionals and the Missouri GIS Advisory Council to do GIS in their local communities, especially going out into schools. The council supports and helps guide Missouri's geospatial program statewide. Its members represent a cross section of organizations, including counties, cities, universities, businesses, nonprofit organizations, and federal and state agencies.

"We think that's where the next generation of users will come from because they're going to learn about it there," says White, a PhD geospatial extension specialist in the University of Missouri's Department of Geography in Columbia, Missouri.

Of the GIS Day website's new look and functionality, White says, "The best thing is the resources for hosts page—by far, hands down—for any GIS professional who is a little bit intimidated about presenting about GIS. You can take some of the PowerPoint slides and then customize them for your own purposes. I think that's a wonderful, wonderful resource."

White also likes the Events Map: "All of a sudden, you start to see yourself on the map, so that's a great thing—because as mapping professionals, we should be showing ourselves on the map."

For more information on GIS Day and how to host an event, visit **gisday.com**.

New Training and Certification Offerings from Esri

Training

Instructor-Led Training: ArcGIS 10.1 for Server Courses
Reflecting the major changes introduced at ArcGIS 10.1 for Server, the instructor-led training curriculum for the data management and web services aspects of ArcGIS for Server have been reenvisioned for the ArcGIS 10.1 release. The changes are summarized below.

Data Management
For ArcGIS 10.1, our instructor-led geodata curriculum consists of these four courses:

- **Building Geodatabases—**This course teaches essential concepts needed to store and realistically model geographic data in a geodatabase. Course topics apply to file-based and multiuser geodatabases.
- **Configuring and Managing the Multiuser Geodatabase—**Designed for database administrators who need to create and deploy a multiuser geodatabase to support enterprise workflows, this course is database agnostic and focuses on workflows that are applicable across platforms.
- **Implementing Versioned Workflows in a Multiuser Geodatabase—**Designed for GIS database administrators and managers, this course covers how to set up and manage a multiuser editing environment and deploy a versioning workflow that meets organizational needs.
- **Distributing Data Using Geodatabase Replication (available early 2013)—**Designed for GIS database administrators and managers, this course teaches how to implement geodatabase replication to support efficient, secure enterprise data management workflows.

Web Administration and Mapping
For ArcGIS 10.1, we are offering the four courses below:

- **ArcGIS for Server: Sharing GIS Content on the Web—**Designed for GIS professionals, this course teaches how to deliver maps and other geographic information as web services that are accessible to both colleagues and non-GIS audiences.
- **ArcGIS for Server: Site Configuration and Administration (available early 2013)—**Designed for IT and system administrators who are new to ArcGIS 10.1 for Server. Course topics focus on the Windows environment, but many apply to Linux, as well.
- **Migrating to ArcGIS 10.1 for Server—**Designed for experienced administrators of an existing 9.3 or 10.0 system, this course provides information and hands-on experience needed to implement a suitable migration strategy. Course topics focus on the Windows environment, but many apply to Linux, as well.
- **System Architecture Design Strategies—**Designed for software architects, GIS managers, and IT and system administrators, this course covers GIS architecture design strategies and infrastructure architecture alternatives that support successful enterprise operations.

View the complete instructor-led class schedule at **esri.com/ilt**.

Certification

10.1 Certification Exams Coming This Fall
Updated ArcGIS 10.1 certification exams will begin being released later this fall. The ArcGIS Desktop Associate 10.1 and ArcGIS Desktop Professional 10.1 exams will be the first available. The following 10.1 certification exams are scheduled to be released through 2012 and in 2013:

- **ArcGIS Desktop Associate 10.1**
- **ArcGIS Desktop Professional 10.1**
- **Web Application Developer Associate 10.1**
- **Enterprise Administration Associate 10.1**
- **Geodatabase Management Associate 10.1**

New Payment Options for Certification Exams
Exam vouchers may still be purchased directly from the test provider (Pearson VUE) via credit card but are now also available directly from Esri by requesting a quote from GIStraining@esri.com or by calling 800-447-9778, extension 5757. Through Esri, vouchers may be purchased using a credit card, purchase order, government requisition, or prepaid credits acquired through programs such as the Esri Enterprise Advantage Program or Esri Training Pass. These new options offer individuals and organizations more flexibility for acquiring their exam vouchers.

Esri Technical Certification exams are also covered under the GI Bill. Qualified candidates can purchase their exam voucher and submit a form for reimbursement under the GI Bill provision. Get more information about the different payment options at **esri.com/certification/registration**.

For More Information

Training website:	**esri.com/training**
Find a course:	**esri.com/coursecatalog**
Training Matters blog:	**esri.com/trainingblog**
Training on Twitter:	**twitter.com/esritraining**
Subscribe to the training newsletter:	**esri.com/trainingnews**
Esri Press books:	**esri.com/esripress**
Esri Technical Certification website:	**esri.com/certification**
Esri Technical Certification exam registration site:	**pearsonvue.com/esri**
Esri Technical Certification prep resources:	**esri.com/skillsreview**

NATIONAL GEOGRAPHIC™

"Geo Learning"

A column by Daniel C. Edelson,
Vice President for Education, National Geographic Society

Break-the-Mold Approaches to Geography Learning

Before you read this column, I want you to pause for a moment to consider the following question: How could we make geography learning more enjoyable for young people?

My nonscientific research indicates that about 1 percent of the general public enjoy learning geography so much that they cannot imagine a way to make it more enjoyable (you know who you are). The rest of us tend to generate ideas like making geography learning into a game, making it more relevant, or adding rewards.

I don't think people's answers to the question are nearly as interesting as what flashes into their minds when asked to think about geography learning. My nonscientific research on this reveals that most of us picture very traditional classroom activities: memorizing place-names and locations, learning to interpret maps, reading about foreign cultures, analyzing population pyramids, and tracing migration paths. Two things tend to characterize that image: it doesn't feel relevant or useful to the learner, and it doesn't feel inherently enjoyable. So when we think about improving geography learning, we think about how we can change those experiences.

There are a small number of people out there, however, who summon up very different images when they think about geography learning. Maybe they never experienced traditional geography education, or maybe they experienced it and have completely rejected it as a model for learning. They envision activities that feel both relevant and enjoyable. These are the people we need to find and listen to, because they don't think about improving geography education by incrementally improving traditional approaches. They think about completely new approaches to geography teaching and learning.

One place where you can find people like that is in the Geography Collective, a group of innovative thinkers in the United Kingdom. They describe themselves in the following way: "We are a collective of geography activists, teachers, therapists, academics, artists, and guerrillas. We've come together to encourage [young] people to see our world in new ways."

The members of the Geography Collective characterize themselves as "guerrilla geographers," and their goal is to engage others in guerrilla geography. By their definition, guerrilla geography consists of "operations carried out by small, independent geographers to cause thought [and] connected thinking, stimulate the public, and to wear down public resistance to geography, usually carried on by a number of small groups behind public lines or in occupied spaces. . . . Guerrilla geography is irregular [direct action] educating."

Its approach to engaging people in guerrilla geography is through a set of miniadventures that are designed for young people to do by themselves or with adults. These adventures—or "missions," as the Geography Collective calls them—encourage exploration. They challenge participants to explore either new or familiar places with new perspectives.

These missions are always quirky and often have a sense of playful mischief about them. One mission asks explorers to locate places where one neighborhood ends and another begins and then explain how they know. Another asks them to "go outdoors in search of the most beautiful poo you can find [it's a kid thing]. When you discover it, take a picture of it." A third asks them to explore the world from a bug's-eye view by taking macrophotographs. And a fourth, called Avoid Seeing Red, instructs explorers, "If you see red, shield your eyes, look irritated, and walk in another direction."

The Geography Collective shares its missions with children, parents, and educators through a series of books and a website, Mission:Explore. The website offers points for completing missions and allows explorers to collect points toward "badges" as rewards.

Behind the playfulness and quirkiness of the Geography Collective's missions are carefully considered philosophical and educational stances. One is that young people should be encouraged to explore their surroundings and express their own opinions about the positive and negative aspects of different spaces. Another is that they should recognize their own role in shaping the world. Underlying all of what the Geography Collective does is the goal of teaching geography as a method for observing the world and deciding how to act in it.

The Geography Collective does not position its approach to geography learning in opposition to traditional geography or even as an alternative. It presents its approach as providing an additional set of experiences that are disappearing from the modern world, where children are taught that all the interesting things in the world have already been discovered and adults believe it's more important to protect young people from the hazards of the world around them than to give them the chance to explore it.

The Geography Collective is one of the most creative groups in geography education today, and every time I learn more about its work, I get more excited about it. However, I do find myself wishing that creative approaches to geography teaching and learning were not so unusual. This is just one transformative approach to geography learning, and it is not going to resonate with everyone. Where the Geography Collective's approach is quirky and playful, others might be practical and serious—but equally effective and motivating to learners.

I can't help feeling that truly creative approaches to geography learning are discouragingly few and far between right now. Too few people are even thinking about geography education, and those who are still focus too much on incremental improvements rather than entirely new approaches. We should take the Geography Collective members and others like them as inspiration. We must challenge ourselves to think more creatively and seek out and promote the creative ideas of others.

Of course, you may already have a break-the-mold idea for fostering geography learning, or you may know someone else who does. If so, please share it with me on the Geo-Literacy page on Facebook (**facebook.com/geoliteracy**) or on Twitter at @NatGeoEdelson.

The Geography Collective's Mission:Explore website.

Esri Launches New Partner Directory

The all-new Esri Partner Directory makes it easy to find innovative solutions and services from Esri Partners across the globe. With easy access to information on more than 1,600 Partner listings, the new Partner Directory allows filtering by industry, types of solutions and services, location, keywords, and more.

Search the Partner Directory today to find the Partner, solution, or service that's right for you. Visit **partners.esri.com**.

ArcGIS for Server Disseminates Geospatial Services

Esri's ArcGIS for Server adds geographic data and analysis to web applications that serve organizations and communities in a variety of ways. To submit an ArcGIS for Server site address and view other websites powered by ArcGIS for Server, visit **esri.com/serversites**.

Future Climate Models
climatewizard.gis.com/tnc/FutureClimateModels.html
Future Climate Models is a JavaScript application that lets users interactively investigate and compare various future climate models and scenarios.

Hudson Bay Beluga Project
oceansnorthportal.org/flexviewers/HudsonBayBelugaWebmap1
Oceans North Canada, in collaboration with Canadian partners, created a site documenting a three-year study on the western Hudson Bay population of beluga whales.

Digital Egypt
www.digitaleg.com/Digital_Egypt/Egypt-Map/Map-of-Egypt.html
Digital Egypt allows visitors to view dynamic maps, check weather in real time, and view 360-degree panoramic images of Egyptian landmarks and neighborhoods.

Renewable Energy Atlas of Vermont
www.vtenergyatlas.com
The atlas is a new tool for identifying, analyzing, and visualizing existing and promising locations for renewable energy projects.

"Managing GIS"

A column from members of the
Urban and Regional Information Systems Association

URISA
The Association For GIS Professionals
www.URISA.org

Geospatial Society, the GIS Profession, and URISA's GIS Management Institute

By Greg Babinski, GISP, Finance and Marketing Manager, King County GIS Center, URISA President

At around the time that this article is published, URISA will hold its 50th annual conference—GIS-Pro 2012—in Portland, Oregon. URISA—the Urban and Regional Information Systems Association—originated at a time when geospatial technology did not exist. Indeed, as Jack Dangermond recently reminisced (*ArcNews*, Summer 2012: "URISA at 50: An Interview with Jack Dangermond"), the history of GIS development is linked closely with URISA.

Past

The world of 50 years ago was much different, with a total population of less than half what it is today. Geography as an academic discipline was struggling for relevance, and GIS existed as neither a technology nor a profession. In the early 1960s, Professor Edgar Horwood from the University of Washington, Seattle, established a short course on computerized data mapping. A conference for his course alumni was held in 1963 and is considered the first URISA annual conference, even though the association was not formally organized until 1966.

For five decades, URISA has thrived with a basic formula for conference papers, articles, and courses: how to use new technology X plus spatial data Y for government business purpose Z.

As GIS software and other new technologies matured during the past decades, URISA helped the geospatial community develop and deliver value for society.

URISA's nearly 50 years of annual conference proceedings—as well as the *URISA Journal*, the *GIS Professional*, various books, quick study guides, workshops, and Exemplary Systems in Government (ESIG) Awards—document a half-century's development of intellectual capital. Hundreds of domains of knowledge have been created by URISA and documented in its publications.

Present

Today URISA remains a vital resource for the GIS community. In addition to GIS-Pro, URISA has a portfolio of specialty conferences (Addressing, Transit, CAMA, Public Health, Caribbean), 20 daylong workshops, and the weeklong GIS Leadership Academy. URISA has 29 chapters (including its first outside North America—in the UAE), as well as a formal affiliation with Surveying & Spatial Sciences Institute in Australia and New Zealand.

URISA's GIS Management Institute: How will the GMI operate?

URISA has a proven track record of launching major new initiatives, including the GIS Certification Institute (www.gisci.org), the Coalition of Geospatial Organizations (www.urisa.org/cogo), and GISCorps (www.giscorps.org).

Most recently, URISA was instrumental in the development of the US Department of Labor Geospatial Technology Competency Model and took the lead in developing the new Geospatial Management Competency Model. In parallel, URISA published the proposed Local Government GIS Capability Maturity Model (*ArcNews*, Winter 2010/2011: "URISA Proposes a GIS Capability Maturity Model").

Future Geospatial Society, URISA, and the GIS Management Institute

The world is geospatially connected today in ways that it was not 50 years ago. Then, only one-third of the world's population was urban. Today, according to the UN, for the first time in world history, more than half the world's people live in cities; within the next 50 years, more than two-thirds will be urban. How will we fit two billion more people into livable cities? *Urban* is important, and today URISA is as relevant to the future as it ever was.

Technology also presents the geospatial community with new opportunities today. Cheap global air travel, shipping, and telephony, as well as the Internet, did not exist 50 years ago. The Cold War is long over, and the frontier of the developed, postindustrial world advances to provide more people with new economic opportunity. An international approach for the GIS profession is within reach.

Are there new frontiers in URISA's future? Three articles in the summer 2012 issue of *ArcNews* confirm a new direction that URISA is pursuing. David DiBiase's article ("Strengthening the GIS Profession") suggests that there is a moral imperative for GIS. Another article ("King County Documents ROI of GIS") proves that GIS provides significant financial benefit to society. Lastly, the Jack Dangermond interview (referred to above) suggests an important management focus for URISA's future.

At the 2012 Esri International User Conference, URISA announced a new initiative to develop the GIS Management Institute (GMI) (www.urisa.org/gmi_pr). GMI will develop resources and services that focus on promoting the advancement of professional best practices and standards for the management of GIS operations.

GMI will build on resources that URISA has already developed, including the GIS Capability Maturity Model, the Geospatial Management Competency Model, the ESIG Awards, and the URISA Leadership Academy. A key component of the GIS Management Institute will be the development of the GIS Management Body of Knowledge (GMBOK).

The GIS Management Body of Knowledge will be the central unifying element of GMI. It will be used to refine the GIS Capability Maturity Model (GISCMM) and the Geospatial Management Competency Model (GMCM). The GMBOK will be a collection of peer-reviewed best practices and standards that can inform geospatial managers and operations to improve the effectiveness of their use of geospatial technology.

GMI will develop programs based on the GMBOK to accredit the capability and maturity of GIS operations against the GISCMM. It will also develop a program to accredit GIS management educational programs using the GMBOK and GMCM. URISA has agreed to work in cooperation with the GIS Certification Institute to advance the future certification of GIS managers.

The management of enterprise GIS operations requires knowledge, skills, and abilities that clearly set it apart from other management domains. GIS operations today are highly complex, are critical for effective agency services, and have been proved to deliver tremendous financial benefits. Central to GMI is the theory that as GIS operational maturity improves, return on investment from GIS increases.

GMI has been designated as a priority initiative. It will become an operational program of URISA. It is intended to be an international initiative with a global geospatial advisory council.

URISA does not intend to turn its back on the broad urban and regional information systems domains that have been important for the past 50 years. They are critical for helping to plan and build the highly urban society of the future. But URISA intends to serve society and strengthen the GIS profession by helping to promote the professional management and effective use of GIS into the future.

About the Author

Greg Babinski, MA, GISP, is the finance and marketing manager for King County GIS Center in Seattle, Washington, where he has worked since 1998. Previously, he worked for nine years as GIS mapping supervisor for the East Bay Municipal Utility District in Oakland, California. He holds a master's degree in geography from Wayne State University in Detroit, Michigan. Babinski is the president of URISA.

For more information, contact Greg Babinski, King County GIS Center (tel.: 206-263-3753, e-mail: greg.babinski@kingcounty.gov).

ArcGIS 10.1: Transform Your Organization Seminar

From September to November 2012, Esri is offering a seminar in 41 cities across the United States as part of the Success with GIS seminar series. During the ArcGIS 10.1: Transform Your Organization seminar, Esri staff will demonstrate how ArcGIS 10.1 improves collaboration and sharing of geographic knowledge within and across government, businesses, and citizen groups.

We hope you can attend in person, but if not, Esri will make the content of the seminar available on the website at the conclusion of the seminar.

For more information or to register, visit esri.com/transformyourorg.

Fourth Annual Geodesign Summit Reveals Newest Developments

The latest geodesign ideas, methods, and tools will be presented at the fourth annual Geodesign Summit, an event for anyone working at the intersection of geography and design.

The summit will take place at Esri in Redlands, California, January 24–25, 2013. The theme of this year's Geodesign Summit, "Reimagine Your World," will invite participants to see how geodesign can be used to realize the best possible outcomes for both their projects and the planet.

For more information and to register, visit www.geodesignsummit.com/arcnews.

"Crossing Borders"

A column by Doug Richardson,
Executive Director,
Association of American Geographers

Help Develop Themes for the AAG Los Angeles Meeting

Each year, the AAG identifies a few featured themes for its Annual Meeting, and I'd like to invite you to help us this year as we plan the program for the Los Angeles (LA) meeting. In past years, themes have included topics such as space-time integration in geography and GIScience, climate change, geography and human rights, historical GIS, and geography and sustainable development.

We invite you and the Esri user community to help us develop ideas for themes by suggesting new ideas for Los Angeles, and for coming years, as well. Themes are often suggested by the meeting's location itself or by political and intellectual trends within the discipline or in society at large. Los Angeles, for example, readily prompts many possibilities. International cities and urban geographies would be a natural theme for the LA meeting. Water is always a dominant consideration for Los Angeles. Others come immediately to mind: the Pacific Rim and Asia. Borders. Migration and immigration. Hollywood, film, and global cultures. Transportation. And so many more.

Please send me an e-mail (drichardson@aag.org) with your ideas for special themes that you would like to see covered during the AAG's Los Angeles meeting or any comments you may have on important new trends we should be thinking about for AAG's meetings. To stimulate our thinking, below are a few examples of possible themes that are beginning to emerge for the AAG Los Angeles meeting, which is scheduled for April 9–13, 2013. You are also invited to present a paper or poster during the meeting on any topics you think are important, sharing your work and discussing your ideas with an expected 8,000 geographers, GIScientists, and GIS specialists from around the world.

Emerging Asias

Acknowledging Los Angeles's and California's location on the Pacific Rim and their increasing interconnections with Asia, AAG president Eric Sheppard's 2013 presidential plenary session will take up the question of "Emerging Asias." This title references three aspects of Asia today: its rapid (re)emergence as a center of the global economy; its enormous diversity as a region; and, within the heterogeneous subregions of Asia, the expanding differences in the livelihood possibilities of those who have come to live prosperously and those who live precariously.

In the 21st century, the center of gravity of urbanization has relocated decidedly into the Global South, and Asia in particular is experiencing unprecedented rates of urban change. The urbanization of poverty has been a central aspect of these changes, as circular rural-urban migration, low-wage manufacturing and informal economies and settlements, and urban politics accompany the emergence of a consumption-oriented urban middle class. How can we better understand these changes? What are the implications for northern cities? These and related questions are becoming widely debated; LA will be an excellent forum to engage further with them.

GIScience, Geography, and Health: Spatial Frontiers of Health Research and Practice

Building on several recent AAG initiatives, together with the National Institutes of Health (NIH) in this research area, this theme will explore new research frontiers in health and social environments and also address progress generated by the AAG Initiative for an NIH-wide Geospatial Infrastructure for Health Research. These AAG initiatives have generated a greatly increased awareness by health researchers, as well as geographers, of the core role that geography and GIScience can play in addressing global health needs, both in research and in practice.

Sessions will include leading medical and health researchers, and we encourage GIS specialists and geographers active in health to present their work. Topics addressed in these sessions will include spatial analysis and modeling of disease; health disparities and inequalities; mobilities and health; exposure monitoring utilizing real-time GPS/GIS methods; genomes and geography; environmental health (including interactions among environment, pathogens, humans, and institutions); spatial patterns of drug abuse and treatment; gene-environment interactions; and mHealth and global health service delivery initiatives, among many others.

Climate Change, Variability, Adaptation, and Justice

This track of sessions would examine the latest research on global climate change and variability, including geographies of projected climate change impacts, mitigation and/or local adaptation strategies, and societal and human rights implications. The Obama administration's recent Strategic Plan for US Global Change Research for the next decade will also be the focus of discussion in terms of its potential opportunities for geographic and GIScience research related to global and climate change. This US Global Change Research Plan directly addresses central roles for geographic and GIScience research, urging researchers to conceptualize global change "at the spatial and temporal scales on which planning, management, and policy decisions are made." The plan also places increased emphasis on integrated human/natural dimensions of global change. Sessions addressing activities and outcomes of the United Nations Conference on Sustainable Development (Rio+20) will also be encouraged as part of this theme.

Borders

Southern California is an excellent venue for advancing research on political borders and their implications for the places they separate and the connectivities between them: migration, language and culture, water, sovereignty, economies, etc. The United States-Mexico border provides a compelling regional focus for this theme, and research and theoretical work related to borders elsewhere is also welcome. Field trips to border areas will also enrich these sessions.

These multifaceted themes are not intended to be the exclusive focus of an AAG meeting but, rather, serve as a lens to help focus discussion and provide a fresh and engaging skeletal structure to each of our large and richly complex meetings. The dynamism, innovation, and range of cutting-edge research presented at AAG Annual Meetings are always remarkable, and we encourage the broadest range of geographic scholarship and research at our meetings. The AAG Specialty Groups also develop their own featured sessions each year, and we encourage prospective attendees to contact the AAG Specialty Group in their areas of research interest to help build strong session tracks around the many diverse and interactive topics and regions that they represent.

For more information, visit **www.aag.org/annualmeeting**.

I look forward to receiving your good ideas for additional themes and to seeing you at the AAG Annual Meeting next April in Los Angeles, a most creative and fascinating "transnational" city!

Doug Richardson (with input from Eric Sheppard) (e-mail: drichardson@aag.org)

New Books from Esri Press

***GIS Tutorial for Health*, Fourth Edition**
By Kristen S. Kurland and Wilpen L. Gorr
In its fourth edition, *GIS Tutorial for Health* is fully revised and updated for ArcGIS 10 software. To better support skill building and GIS analysis, this workbook features extended introductions to 11 tutorials addressing significant issues of health care and policy planning. Step-by-step exercises cover health map basics, data preparation for maps, and spatial analysis of health issues using GIS. Complete with a 180-day trial of ArcGIS 10 for Desktop and exercise datasets, this book is a valuable resource for the classroom, as well as the individual user. ISBN: 978-1-58948-313-2, 466 pp., US$79.95.

GIS and Cartographic Modeling
By C. Dana Tomlin
GIS and Cartographic Modeling is a foundational work in the field of GIS. An introduction to the concepts, conventions, and capabilities of map algebra as a general language, this book describes the analytical use of raster-based GIS. By focusing on the fundamentals of cartographic modeling techniques, C. Dana Tomlin illustrates concepts that can be applied to any GIS. This publication of *GIS and Cartographic Modeling* contains updated graphics and a new preface. ISBN: 978-1-58948-309-5, 204 pp., US$45.95.

Economic Development and GIS
By J. M. Pogodzinski and Richard M. Kos, AICP
Economic Development and GIS shows why GIS software is an essential tool for economic development planning and analysis. The book describes policy problems in economic development and then presents methods and techniques to solve them with GIS. *Economic Development and GIS* uses examples from Esri Business Analyst and ArcGIS software to explain the value of GIS in economic development decision making. ISBN: 978-1-58948-218-0, 244 pp., US$65.95.

***Measuring Up: The Business Case of GIS*, Volume 2**
By Christopher Thomas, Brian Parr, and Britney Hinthorne
Measuring Up: The Business Case for GIS, Volume 2, is a collection of real-world stories from government agencies that have successfully used GIS technology to meet business goals. Chapters focus on how implementing automated GIS workflow and resource management solutions helps organizations save time and money, increase accuracy and efficiency, and maximize productivity and revenue. The articles in this collection illustrate how GIS is being utilized to implement new, more efficient business processes and show how these emerging practices have improved communities and organizations. ISBN: 978-1-58948-310-1, 128 pp., US$19.95.

For more information about Esri Press books or to order, visit **esri.com/esripress**.

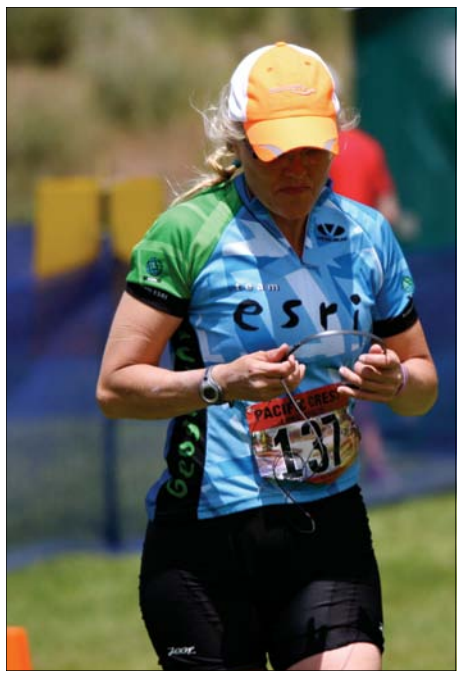
Greece and Oregon Esri T-shirts Glow!

Nadika Senadheera, GIS consultant, United Nations World Food Programme, is shown in front of the Odeon of Herodes Atticusby (Athens, Greece). She says that wherever she travels—for example, Cambodia, Malaysia, Pakistan, Italy, Lao PDR, Thailand—she always has an Esri T-shirt with her. Talk about dedication!

Dorothy Mortenson, GIS developer, Oregon Water Resources Department, is seen coming out of Transition 2 of the Pacific Crest Half Ironman event in Sunriver, Oregon. She says, "Beautiful area, great event, and the shirt was perfect for the bike and run."

Wear an Esri T-shirt in a unique location and send a photograph to *ArcNews*. Photos will be considered for use in *ArcNews*, the expanded T-shirt section at *ArcNews* Online, or both. Upload digital photos at *ArcNews* Online or send them via e-mail (tmiller@esri.com). Digital images are preferred, but prints or slides can be sent to *ArcNews* T-shirt Feature, Esri, 380 New York Street, Redlands, California 92373-8100 USA. See *ArcNews* Online at **esri.com/arcnews**.

Nadika Senadheera



Dorothy Mortenson

URISA'S 2012 GIS Hall of Fame Inductees

The Urban and Regional Information Systems Association (URISA) established the GIS Hall of Fame in 2005 to recognize and honor the most esteemed leaders of the geospatial community. This year, the GIS Hall of Fame Nomination Committee, comprising URISA past presidents, proposed five federal agencies that have made substantial contributions to the GIS community and profession. URISA is pleased to welcome the 2012 GIS Hall of Fame inductees:

- National Aeronautics and Space Administration
- Natural Resources Canada
- Statistics Canada
- United States Census Bureau
- United States Geological Survey

The 2012 inductees join the following esteemed members of URISA's GIS Hall of Fame:

- 2011 Inductees: William Huxhold and Barry Wellar
- 2010 Inductee: C. Dana Tomlin
- 2009 Inductees: Will Craig and Carl Reed
- 2007 Inductees: Don Cooke and Michael Goodchild
- 2006 Inductee: Gary Hunter
- 2005 Inductees: Jack Dangermond, the Harvard Lab, Edgar Horwood, Ian McHarg, Roger Tomlinson, and Nancy Tosta

For more information about URISA's GIS Hall of Fame, visit **www.urisa.org/hall_of_fame**. For more information about URISA membership, advocacy programs, and education, visit **www.urisa.org**.

Online-Only Articles

More *ArcNews*

The Fall 2012 issue of *ArcNews* Online (**esri.com/arcnews**) presents the following special online-only articles:

- **Esri Young Scholars Award Winners Honored at International User Conference**
- **European Environment Agency Receives Prestigious Honor at Rio+20 Sustainable Development Conference**
- **Modeling the Movement of Lost People**

Esri Young Scholars Award Winners

Coordinated by Esri's international distributors and its education teams, the Esri Young Scholars Award program was launched at the 2012 Esri International User Conference. The program recognizes the exemplary work of undergraduate and graduate students majoring in geospatial science disciplines at international universities. The article is available at *ArcNews* Online: **esri.com/arcnews**.

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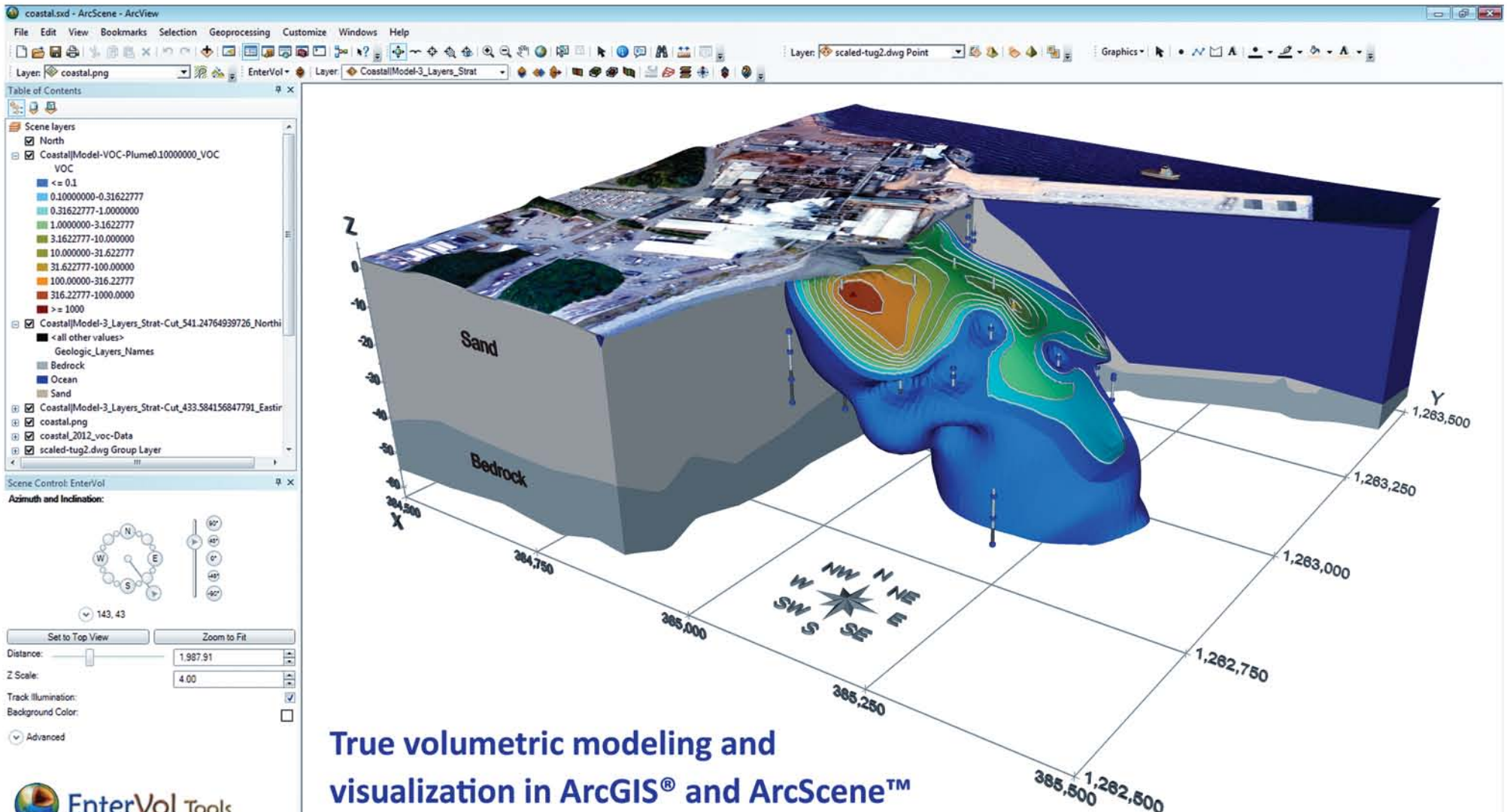

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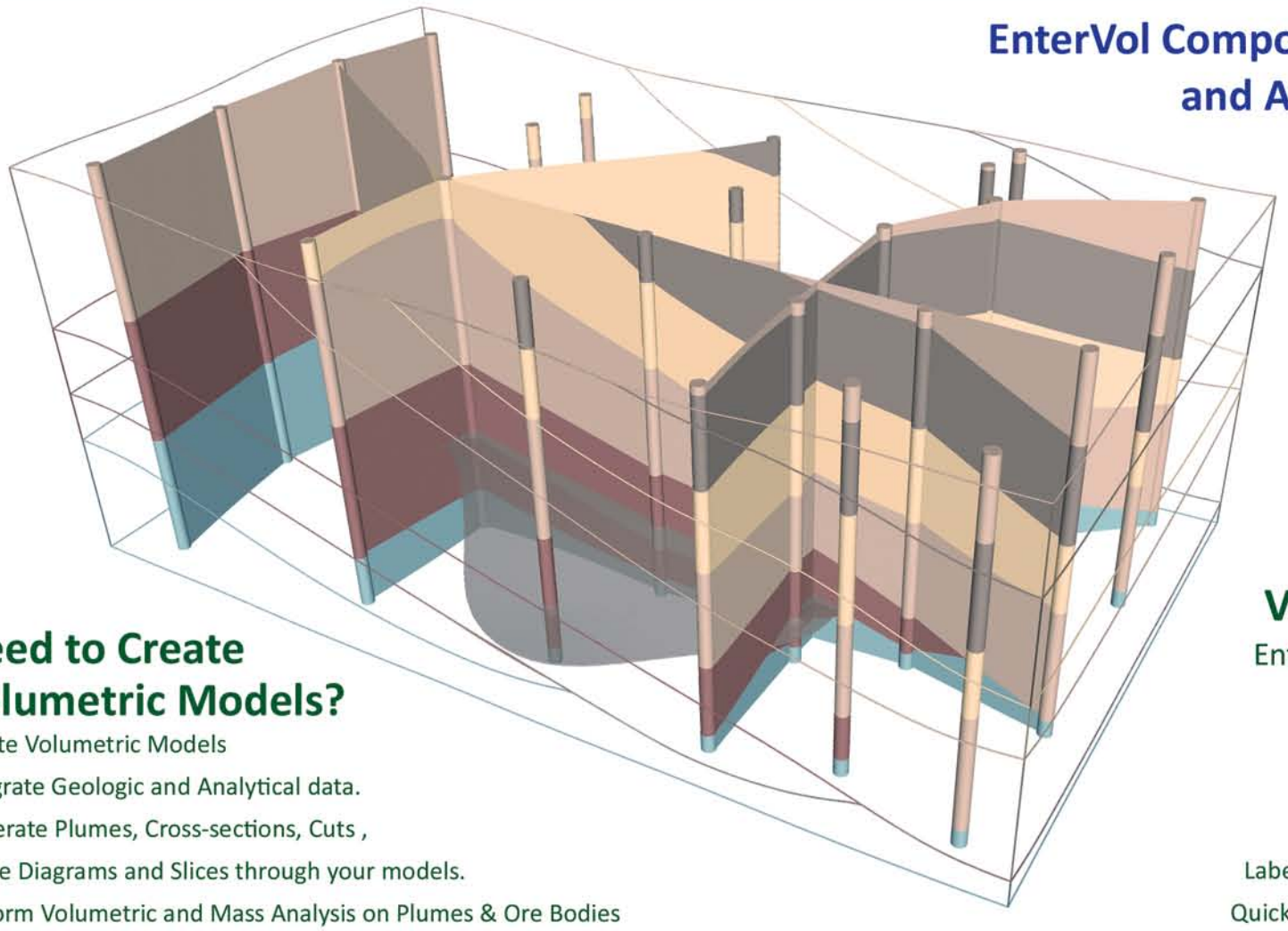

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